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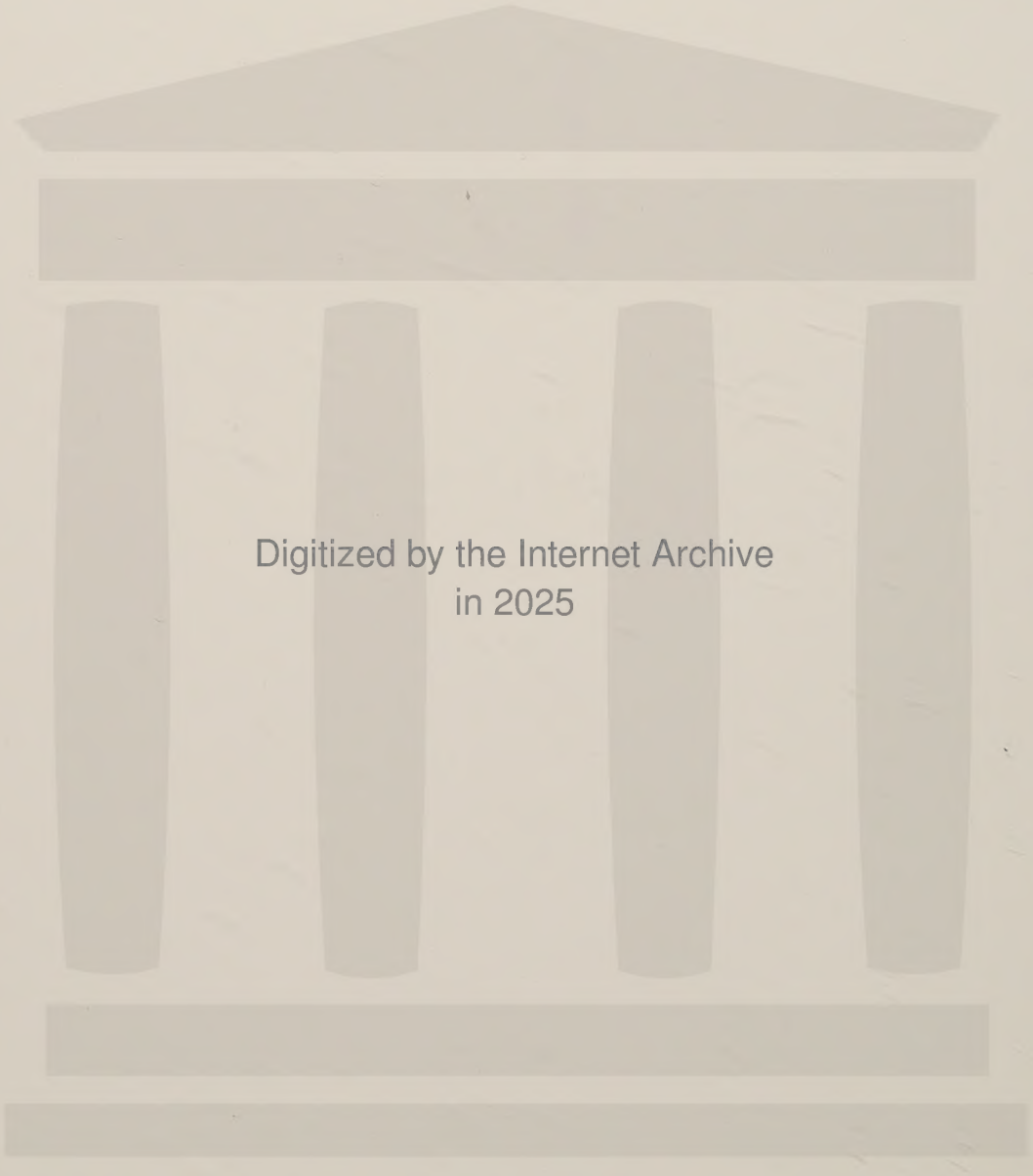

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In brief

Consultation

ONS is consulting users on one of their outputs, life expectancy by socio-economic classification.

Currently, two series of data are maintained:

- Trends in life expectancy by (Registrar General's) social class
- Trends in life expectancy by National Statistics Socio-economic Classification

The historical categories of the Registrar General's Social Classification (RGSC) system are no longer in use in official statistics, following the introduction in 2001 of the National Statistics Socio-economic Classification. The consultation proposes that the future series 'Trends in life expectancy' is maintained and updated using NS-SEC rather than RGSC. Considerable work would be saved by this action, including the need to produce social class data for 2011 and beyond.

Work on the Longitudinal Study (LS) made it possible to approximate NS-SEC for the 1981 and 1991 censuses, which meant that the NS-SEC series could be extended prior to 2001. Similarly, the RGSC series was continued after 2001. Currently, these two series overlap for the period 1982–2006. The consultation document includes comparisons of the two outputs for males and females. The consultation document is available on our website at: www.ons.gov.uk/ons/about-ons/consultations/open-consultations/index.html

If you would like further information about these proposed changes, or would like to give us your views, please contact Joanne Evans by email at healthineq@ons.gsi.gov.uk.

Geography change for life events data

For releases of 2011 data for life events (ie births, conceptions, deaths, marriages, civil partnerships), outputs will comply with the Geography Policy for National Statistics[1] and ensure that statistics for any geography is built from statistical building blocks (ie output areas) on a 'best-fit' basis. The geography policy ensures statistics are referenced and output consistently, and that they are more easily compared on a common standard geographical base. This approach is also consistent with planned outputs for 2011 population estimates and 2011 Census.

Analysis was carried out on the impact of the new policy on life event outputs and there was little change for local authority data. There were larger changes for ward data but the extent of change was similar to that resulting from postcode updates which traditionally took place on a quarterly basis with the former policy. A full report of the analysis will be published on the ONS website in the winter.

For further information please email: vsob@ons.gov.uk or visit:

www.ons.gov.uk/ons/guide-method/geography/geographic-policy/best-practice-guidance/geography-policy-for-national-statistics.pdf

National Survey of the Bereaved (VOICES) Survey

The National Bereavement (VOICES) Survey is the first national survey to monitor service delivery and further inform service improvements for End of Life Care. ONS is carrying out the survey on behalf of the Department of Health to support the NHS Outcomes Framework.

The survey is being managed by the Health and Life Events Division (HLED) who have selected the sample from the death registrations database, sending the questionnaire to the informant on the death certificate. Analysts within HLED will produce a report for the Department of Health for England as a whole but will also describe findings for health regions. The main report will be published by the end of March 2012.

Key areas of interest are:

- dignity and respect
- co-ordination of care
- relief of pain and suffering
- support in the last two days of life
- patients' needs and preferences
- support for carers
- preferred priorities for care
- after death support

Recognising that this may be a sensitive issue for respondents, HLED have worked with Cruise Bereavement Care services, a national charitable organisation that provides help and support to those who have lost loved ones.

Link to A-Z Surveys..... www.ons.gov.uk/ons/about-ons/surveys/a-z-of-surveys/index.html.

Video podcasts

ONS regularly releases short animated video podcasts on its dedicated Youtube channel www.youtube.com/user/onsstats. Health related podcast releases include National cancer statistics for England, national and sub-national health expectancies and leading causes of mortality.

In conjunction with the article appearing today in HSQ 52 'Trends in socio-economic inequalities in female mortality, 2001-08. Intercensal estimates for England and Wales.' by Brian Johnson and Alaa Al-Hamad, ONS has also released a podcast entitled 'Socio-economic inequalities in mortality in England and Wales'. This podcast briefly describes the background to this important area of research and summarises recent key findings.

For further information please visit our website www.ons.gov.uk/ons/index.html. You can also follow ONS via Twitter: www.twitter.com/statisticsons and Facebook: www.facebook.com/statisticsONS

Trends in socio-economic inequalities in female mortality, 2001–08. Intercensal estimates for England and Wales.

Brian Johnson and Alaa Al-Hamad, *Office for National Statistics*

Abstract

Background

This article presents estimates of annual mortality rates for women of working age by the National Statistics Socio-economic Classification (NS-SEC) for the period 2001 to 2008. Until recently, it was possible to produce such mortality rates only at the time of the decennial census when populations are enumerated by occupation and NS-SEC. In 2010, ONS published annual intercensal male mortality rates using the Labour Force Survey (LFS) to provide population estimates by age and NS-SEC. This article produces the corresponding estimates for women aged 25 to 59.

Methods

The LFS was used to estimate female populations by age and NS-SEC for each year between 2001 and 2008. Numbers of deaths were obtained from death registrations. For both deaths and populations, the combined method of NS-SEC classification was used, whereby the most advantaged of a married woman's and her husband's NS-SEC was used to assign the woman to an NS-SEC class. Single women were classified according to their own NS-SEC. Age-standardised mortality rates were derived for each NS-SEC class by year and a number of measures of inequality estimated for each year so that any trends could be identified.

Results

While overall mortality rates for women declined over the period, this was not true for all NS-SEC classes. Managerial and professional occupations and Routine occupations experienced a statistically significant decline in mortality rate over the period. There was no clear trend for the other classes. Absolute measures of inequality showed no clear trend over the period, but relative inequalities tended to increase. Routine occupations had the greatest decline in mortality rate over the period of approximately five deaths per 100,000 per annum.

Conclusions

Socio-economic inequalities in the mortality rates of women appeared to increase between 2001 and 2008. However, the results for women were not as clear as for men with four out of the seven analytic NS-SEC classes not having a statistically significant downward trend in mortality. The degree of annual volatility in the measures suggests that at the current low levels of mortality of working age women, the LFS could not be used to provide population denominators below the national level. Possibly, three-year moving averages would be better trend indicators, but this would reduce the timeliness of the data to some extent.

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Introduction

Socio-economic inequalities in mortality have been observed and documented for a century in England and Wales. The Black Report (1980), the Acheson Report (1998), and most recently the Strategic Review of Health Inequalities (The Marmot Review 2010) all observed a social gradient in health and recommended action to tackle it.

The monitoring of progress in reducing these inequalities requires timely measures which are capable of regular updating. The conventional method for measurement of inequalities in mortality, since the derivation of Registrar General's social class, involved the use of occupation recorded on death registrations and those recorded at a census in order to estimate the mortality rates for different occupational groups. Among the limitations of this method is the fact that it can only be used once every ten years – at the time of the decennial census. An additional drawback for measuring the social inequality among women is that registrars did not always record occupation for married women.

This article represents an attempt to overcome these problems. It presents, for women aged 25–59, estimated annual mortality rates by the National Statistics Socio-economic Classification (NS-SEC) for the years 2001–2008, along with a number of measures of inequality in mortality derived from these rates. The study uses a methodology developed by the Office for National Statistics (ONS) that uses the Labour Force Survey (LFS) to provide estimates of the population at risk by NS-SEC. It also uses a combined NS-SEC classification for married women based on the most advantaged NS-SEC class of a woman and her husband. It makes possible the comparison of recent trends in mortality of working age women by NS-SEC with those of men over a similar period.

The study also further tests the suitability of the LFS for monitoring socio-economic inequalities on an annual basis.

Background

Social inequalities in mortality among men have been studied continuously since the early Twentieth Century. Corresponding studies of female mortality have been much more rare, as a result of women's historically weaker ties to the labour market and the related difficulties in accurately classifying women to a socio-economic class based on occupation. However, some studies have attempted to measure inequalities in mortality among women. The Black Report (1980) estimated that the death rate for women in the most disadvantaged social class was two and a half times higher than the comparable rates for women in the most advantaged social class. White *et al* (2003) reported similar inequalities for the 1990s, with women in social classes IV and V having a mortality rate approximately one and a half times that of women in classes I and II. Johnson (2011) estimating trends in life expectancy by NS-SEC using the ONS Longitudinal Study found a fairly consistent difference in life expectancy at birth between Higher managers and professional women (the most advantaged) and Routine workers (the least advantaged) of approximately four years between the periods 1982–86 and 2002–06. This study did not provide any sign of a narrowing in the gap between the most and least advantaged women over time.

Owing to the difficulties associated with recording of womens' occupation, studies using non-occupational measures have been attempted for women. For women of working age, mortality differences by housing tenure and access to cars were similar to those for men (Goldblatt,1990). The Department of Health (2009), using an area based deprivation measure to compare mortality in the most deprived areas with the mean mortality rate for England, found an increasing gap between the two, both in absolute and relative terms between 2000–02 and 2006–08.

With the introduction of the new socio-economic classification, NS-SEC, it was necessary to estimate female mortality by NS-SEC as had been done for men by White *et al* (2007). In order to do this, a method of classification had to be used which was based on occupation, but was capable of overcoming the worst effects of the under-reporting of married women's occupation on death and the weaker ties to the labour market of some women compared to men. Langford and Johnson (2009) used a 'combined' measure of the woman's occupation-based class and that of her husband, classifying the woman by the most advantaged class of the two. This concept was based on the labour market 'dominance' approach suggested by Erikson (1984), and assumes that the life chances of individuals in a family unit are more likely to be aligned with that of the most advantaged individual in that unit. Unmarried women were classified according to their own occupation.

Using this measure for deaths over period 2001–03 and the 2001 Census to provide populations by age group on the same basis, a mortality ratio of 2.6 times was found for the Routine occupations compared to the Higher managerial and professional occupations (the least relative to the most advantaged). This was a similar ratio to that obtained for men over the same period.

This method could be used only for the period close to the decennial census. Given the need for more timely and continuous measures of health and specifically mortality inequality, the LFS was considered as a substitute for the census as a provider of population denominators by age and NS-SEC. The standard LFS survey is conducted quarterly and in addition, there are annual versions which include booster samples. Thus, if the LFS sample could be shown to be adequate for this purpose, annual estimates of mortality rates by NS-SEC class and of associated inequalities could be produced.

The approach taken was first to compare the age-standardised mortality rates by NS-SEC for men obtained using the LFS with those using the census for the years 2001–03, (Johnson and Langford, 2010). While there were statistically significant differences between the two sets of results for certain NS-SEC classes, the overall pattern and the scale of inequality were very similar. Following this, a recent article (Langford and Johnson 2010) used LFS based population data to provide annual denominators by age and occupation in order to estimate male mortality rates by NS-SEC for each year between 2001 and 2008.

This article provides corresponding estimates of mortality rates for women of working age over the same period.

Methods

This section describes the measure of socio-economic class along with the data sources used and the outcome measures adopted in this article.

The National Statistics Socio-economic Classification

In this article the National Statistics Socio-economic Classification (NS-SEC) was used as a measure of socio-economic position. It was developed during the 1990s with the aim of replacing both the Registrar General's Social Class and the National Statistics Socio-economic Groups, with a measure having a proper conceptual and theoretical basis (Rose and Pevalin (Eds), 2003). The conceptual basis for the NS-SEC is the structure of employment relations operating in modern developed economies. Occupations are differentiated in terms of reward mechanisms, promotion prospects, autonomy and job security. The most advantaged NS-SEC classes (Higher managerial and professional) typically exhibit personalised reward structures, have good opportunities for advancement, relatively high levels of autonomy within the job, and are relatively secure. These attributes tend to be reversed for the most disadvantaged class (Routine).

The operational categories of the NS-SEC can be derived by three principal methods, full, reduced and simplified depending on the data available. The full NS-SEC requires occupational information coded to the standard occupational classification 2000 (SOC 2000), details of employment status and the size of the organisation. (In this context, employment status refers to whether the person is (or was) an employer or employee, and if an employee, whether they are (or were) a manager or supervisor. It does not relate to whether they were employed or unemployed). The reduced NS-SEC requires occupational classification and details of employment status. The simplified NS-SEC is derived from occupation alone. For the purpose of this article, since the size of the organisation is not recorded on the death register, the reduced method was used to derive NS-SEC throughout.

For the purpose of analysis, NS-SEC is nested so that the operational categories can offer maximum flexibility in terms of the different collapses possible. Box 1 presents the eight-class version of the NS-SEC.

NS-SEC can also be collapsed into three analytic classes. This is known as 'condensed' NS-SEC and comprises:

1. Professional and managerial (consisting of analytic classes 1.1, 1.2 and 2 in Box 1)
2. Intermediate (consisting of analytic classes 3 and 4 in Box 1)
3. Routine and manual (consisting of analytic classes 5, 6 and 7 in Box 1)

This is the conventional terminology for these aggregate groups (Rose and Pevalin (Eds), 2003), and the interpretation of 'manual' in the 'Routine and manual' category is clearly different to that used in the Registrar General's social class schema, which consisted of a hierarchy where all non-manual occupations ranked above manual ones.

The analysis in this study combined classes 1.1 and 1.2 to produce a seven-class framework and also used Condensed NS-SEC, since more aggregative groups possess more statistical robustness, at the cost of masking some of the changes revealed by the more granular schema.

Those without a validly recorded occupation were excluded from this analysis, since they were composed of a disparate range of people and are often coded according to different rules at death registration to those applied by the census or the LFS.

Box 1 National Statistics Socio-economic Classification Analytic classes

Analytic classes

Eight class version				Examples of occupations include
1	Higher managerial and professional occupations	1.1	Large employers and higher managerial	Senior officials in national and local government; directors and chief executives of major organisations; officers in the armed forces
		1.2	Higher professional	Civil engineers, medical practitioners, physicists, geologists, IT strategy and planning professionals, legal professionals, architects
2			Lower managerial and professional	Teachers in primary and secondary schools, quantity surveyors, public service administrative professionals, social workers, nurses, IT technicians
3			Intermediate	NCOs and other ranks in the Armed Forces, graphic designers, medical and dental technicians, local government clerical officers, counter clerks
4			Small employers and own account workers	Hairdressing and beauty salon proprietors, shopkeepers, dispensing opticians in private practice, farmers, self-employed taxi drivers
5			Lower supervisory and technical	Bakers and flour confectioners, screen-printers, plumbers, electricians and motor mechanics employed by others, gardeners, rail transport operatives
6			Semi-routine	Pest control officers, clothing cutters, traffic wardens, scaffolders, assemblers of vehicles, farm workers, veterinary nurses and assistants, shelf fillers
7			Routine	Hairdressing employees, floral arrangers, sewing machinists, van, bus and coach drivers, labourers, hotel porters, bar staff, cleaners and domestics, road sweepers, car park attendants
Non-occupied				Never worked, Long-term unemployed, Full time students, Occupation inadequately described and Unclassified for other reasons

ONS (2007)

Data Sources for analysis

Mortality data

Death registration records were used to identify deaths for working age females (25–59), registered in England and Wales in each of the calendar years 2001 to 2008 together with their occupational classification. However, while for men there is good recording of occupational details at death that allows clear allocation of an NS-SEC occupied class, this is not the case for women. There is a substantial degree of under reporting of the occupations of women at death which makes it more difficult to assign them to an NS-SEC occupied class. Therefore, for females in this analysis it was thought to be most appropriate to use a 'combined' classification whereby a non-married woman is assigned an NS-SEC class on the basis of her own occupation and employment status and a married woman is assigned the most advantaged NS-SEC class of either herself or her husband. (Non-married partners were not recorded on death certificates during this period and so only the spouse's occupation was used in assigning NS-SEC, if applicable).

The mortality data used in this analysis also had to be adjusted to correct for the misallocation of deaths identified by White *et al* (2007). This study found that a number of deaths were likely to have been misclassified as NS-SEC class 3 (Intermediate) rather than class 2 (Lower managerial and professional). This was because some death registration entries failed to record that the individual concerned had a supervisory role. Examination of the ONS Longitudinal Study (LS) revealed that there was evidence from the census that a proportion of these individuals had been supervisors and therefore should have been classified as NS-SEC class 2. A similar analysis was undertaken for women by Langford and Johnson (2009), and the resultant proportional adjustments between the two classes were used throughout the current study, in the absence of any new relevant data.

The same study also observed that for 19 per cent of female deaths between the ages of 25 and 59, insufficient occupational details were available to allow classification by combined NS-SEC classification. Using the Longitudinal Study, in a sample of 158 women who were unclassified by occupation at death, the NS-SEC classification could be determined by reference to their census records. The distribution of this sample then was used to reallocate the unclassified women across NS-SEC classes. For more detail on the process of adjustment of mortality data see Langford and Johnson (2009, page10).

The total number of deaths by combined NS-SEC is shown in the Appendix, Table A3

Population data

The England and Wales female population figures used in this analysis were obtained using annual 2010 weighted LFS datasets, for the years 2001–08 and the ONS mid-year population estimates used to provide control totals by age groups.

The LFS data is a continuous sample survey carried out throughout the United Kingdom to provide information on the UK labour market. It collects detailed data on occupation for a sample of approximately 53,000 private addresses throughout the United Kingdom each quarter. The data are available at national, regional and local authority levels. Response rates were around 65 per cent (see Limitations of the analysis). The results from the survey are weighted to ONS estimates of the private household population (ONS 2010).

Adjustments were made to the population figures for the effect of health selection out of the labour market. This is a phenomenon whereby those already in poor health are less likely to record an occupation and this may have a disproportionate effect across the NS-SEC classes (Fox *et al*, 1985). This can be adjusted for using the LS, since sample members who had no recorded occupation at the 2001 Census could be traced back to the 1991 Census. A high proportion of these, especially in the upper age groups of the study population, did have an occupation at 1991 and therefore could be assigned to an NS-SEC class accordingly.

The exact process of adjustment for health selection follows that described for men in Johnson and Langford (2010). The difference between the ONS mid-year populations for each five year age band (the control totals) and the population in that age group assigned to an NS-SEC class according to the LFS, was defined as the residual population. This residual was split into two groups. The first was obtained by estimating the percentage of the overall mid-year population remaining unclassified by NS-SEC following the health selection adjustments. The remainder of the residual population was reallocated across the 'analytic' or occupation-based NS-SEC classes based on the proportions derived from the LS as described above and shown in Langford and Johnson (2009) for the years 2001–03. For more details on health selection adjustments in this context, see the Appendix to this article.

The total population numbers of woman aged 25–59 by NS-SEC over the study period, based on LFS estimates are shown in the Appendix, Table A4.

Outcome measures

To compare mortality between the different NS-SEC classes, for each year, age-standardised mortality rates for each NS-SEC were calculated, using the European standard population. Confidence intervals for each mortality rate were also calculated, taking into account the variance of the death counts and the sampling variance of the LFS population estimates.

To examine inequalities, two types of indicators were considered, absolute and relative. Absolute indicators measure the difference between the least and most advantaged in terms of the number of deaths per head of population per annum. Relative indicators measure inequality as a ratio of the mortality rate of the least to the most advantaged. Box 2 provides more explanation of the difference between absolute and relative measures of inequality.

Box 2 The difference between absolute and relative measures of inequality

To illustrate the difference between the two types of measures, consider the following hypothetical example where the mortality rate for the Routine class (NS-SEC class 7) is 500 deaths per 100,000 person years, and the mortality rate for the Higher managerial and professional class (NS-SEC class 1) is 100 deaths per 100,000 person-years. Imagine that the rates change to 450 deaths and 75 deaths respectively. In absolute terms of deaths per 100,000 person years, the gap between the most and least advantaged classes is 400 in the first instance (500–100) and 375 in the second instance (450–75). This implies that the inequality, in terms of the absolute number of deaths involved, has reduced.

In the same hypothetical example, however the deaths in the Routine class are five times as high (500/100) as those in the more advantaged class. In the second instance the relative inequalities imply that mortality rates of the disadvantaged are now six times as high (450/75). So inequality in relative terms has become larger.

In this example the reduction in mortality rates for the more advantaged class, the Higher managerial and professional class, has been small in terms of the number of deaths (25 deaths) compared to the reduction achieved in the Routine class (50 deaths). But because the more advantaged class starts at a much lower level the percentage improvement is large (25%) compared to the percentage improvement in the Routine class (10%). Thus because the more advantaged class is at a lower level it is harder to achieve similar percentage reductions in the mortality rate of the more disadvantaged class, and hence maintain the relative gap.

To explore the different potential interpretation of absolute and relative measures of inequalities, three indicators of absolute inequality were calculated. The first indicator was simply the difference in mortality rates between the least and most advantaged NS-SEC classes, using the broad three-class schema. This indicator was the difference between the mortality rates for the 'Managerial and professional' class and the 'Routine and manual' class. The second indicator adopted a similar approach, but was based on the more detailed seven-class version of NS-SEC, and was therefore the difference between the mortality rates of the Routine class and the Higher managerial and professional class (NS-SEC class 7 and 1). The third indicator is the slope index of inequality (SII). This indicator uses all of the available data to model the difference between mortality rates of those with the hypothetically lowest and highest socio-economic position.

Three indicators of relative mortality to compare the position of the more disadvantaged groups relative to the more advantaged group were also calculated. The first was the ratio of the mortality rate of the least to the most advantaged NS-SEC class, using the broad three-class schema. Thus the first indicator was the ratio of the mortality rates of the Routine and manual class to that of the Managerial and professional class. The second indicator was similar, but based on the more detailed version of NS-SEC and was the ratio of the mortality rates of the 'Routine' class and the 'Higher managerial and professional' class (NS-SEC classes 7 and 1). The third indicator is an analogous measure to the SII, the relative index of inequality (RII). This indicator takes into account the intervening classes, in addition to the most and least advantaged classes.

The method of calculation of the SII and RII is shown in Box 3.

Box 3 The calculation of Slope and Relative Index of Inequality (SII and RII)

These indices were calculated following the method described in Sergeant and Firth (2006) and previously used by Kunst and Mackenbach (1994) among others.

The socio-economic groups were ordered, from lowest to highest socio-economic status. The fraction of the population in class i or lower was calculated (c_i), thus c_i represents the cumulative proportion in class i or lower. Each group was then assigned a median social rank

$x = (c_i + c_{i-1})/2$

The mortality rate for each class, y, was then regressed against the median social rank, using group population totals as weights, yielding a straight line estimate, $y = a+bx$

The slope index of inequality(b) represents the difference in mortality rates between the highest and lowest on the socio-economic scale. (As calculated, b is negative, but has been reported as positive for ease of presentation.) The RII was then calculated as a/(a+b) and thus represents the ratio of mortality rates of the least advantaged to the most advantaged.

Results

The age-standardised mortality rates by year and seven-class NS-SEC are shown in Table 1 and Figure 1 and by three-class NS-SEC in Table 2 and Figure 2.

Figure 1 Age-standardised mortality rates by seven-class NS-SEC for 2001–08, women aged 25–59

England and Wales
Rate per 100,000 person years

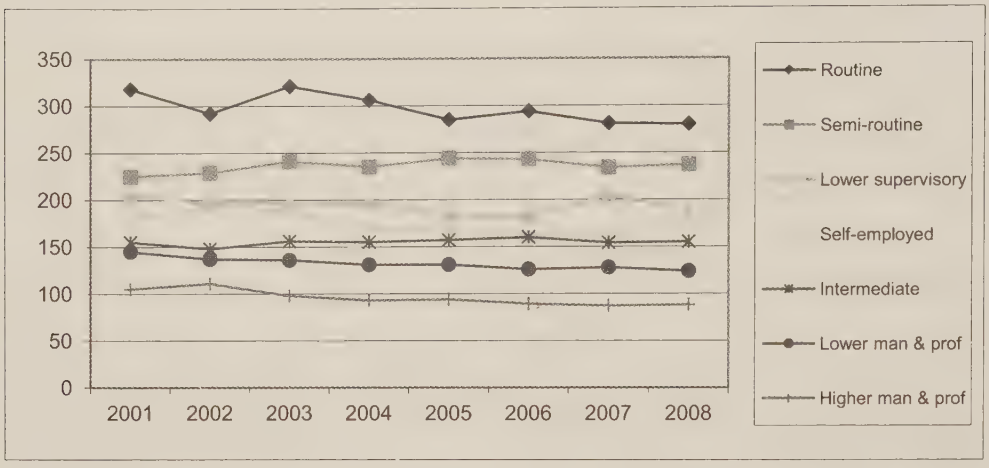


Table 1 Age-standardised mortality rates by seven-class NS-SEC for 2001–08, women aged 25–59

England and Wales — Rate per 100,000

	NS-SEC analytic class						
	Higher managerial & prof	Lower managerial & prof	Intermediate	Self-employed	Lower supervisory	Semi-Routine	Routine
2001	105	145	155	180	205	225	318
	101,110	*141,150*	*148,162*	*170,189*	*195,214*	*216,235*	*301,334*
2002	111	137	148	194	196	229	292
	106,116	*132,141*	*141,154*	*183,204*	*186,206*	*220,238*	*276,308*
2003	98	136	156	189	198	241	321
	93,102	*132,140*	*149,162*	*179,199*	*188,208*	*231,251*	*303,339*
2004	93	131	155	170	197	235	306
	89,97	*127,135*	*148,162*	*160,179*	*187,208*	*224,245*	*288,324*
2005	94	131	157	167	184	244	285
	90,98	*127,135*	*150,164*	*157,176*	*174,194*	*234,254*	*269,302*
2006	89	126	160	163	182	243	294
	85,93	*122,130*	*152,167*	*154,172*	*172,192*	*233,254*	*277,311*
2007	87	128	154	163	204	234	281
	83,91	*124,131*	*147,161*	*153,173*	*193,215*	*224,244*	*265,298*
2008	88	124	155	181	189	237	280
	84,92	*120,128*	*148,162*	*170,191*	*179,200*	*227,247*	*262,297*

Lower and upper 95% confidence limits shown in italics

Source: ONS

Figure 2 Age-standardised mortality rates by three-class NS-SEC for 2001–08, women aged 25–59

England and Wales
Rate per 100,000 person years

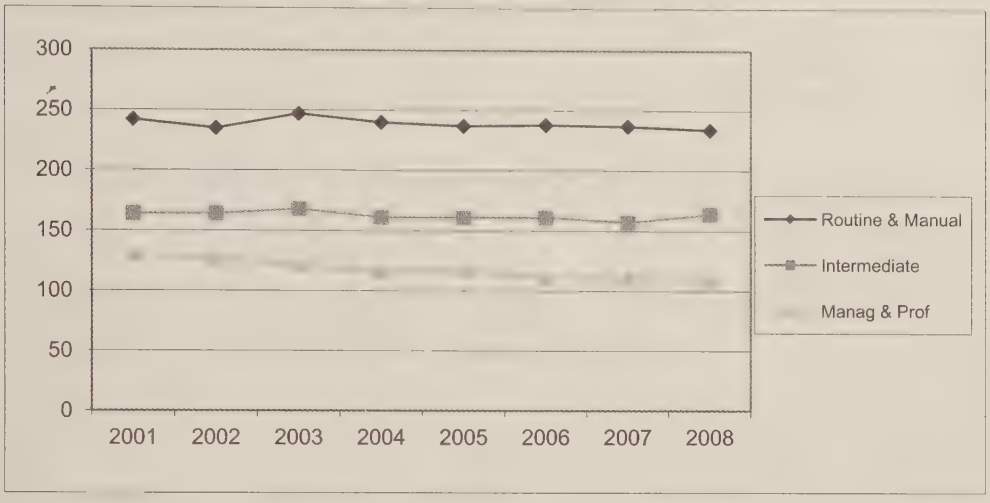


Table 2 Age-standardised mortality rates by three-class NS-SEC for 2001–08, women aged 25–59

England and Wales — Rate per 100,000

	NS-SEC analytic class		
	Managerial and Professional	Intermediate	Routine and Manual
2001	130	164	242
	127,133	*159,170*	*235,249*
2002	127	164	235
	124,130	*159,170*	*228,241*
2003	121	168	247
	118,124	163,174	241,254
2004	116	161	240
	113,119	*155,166*	*233,247*
2005	117	161	237
	114,120	*155,166*	*230,243*
2006	111	161	238
	108,114	*155,167*	*231,245*
2007	111	157	237
	108,114	*152,163*	*230,244*
2008	109	164	234
	107,112	*158,170*	*227,241*

Lower and upper 95% confidence limits shown in italics
Source: ONS

Figure 1 and Table 1 suggest that a socio-economic gradient is present in these estimates. Mortality rates for each year are in a hierarchy according to NS-SEC. Figure 1 also suggests that only Higher managerial and professional, Lower managerial and professional and the Routine class had a pronounced downward trend in mortality. No definite trend was discernible for the other classes, although Self-employed and own account workers would have had a downward trend, had it not been for the 2008 figure which may have been an outlier. Table 3 shows the average annual improvement (with standard errors) for each class.

Table 3 Estimated annual decrease[1] in mortality rate by NS-SEC, women aged 25–59

England and Wales — change in deaths per 100,000 per annum

	NS-SEC	Estimated annual decrease	Standard error
1	Higher managerial and professional	-3.2	0.6*
2	Lower managerial and professional	-2.6	0.4*
3	Intermediate	0.5	0.5
4	Self-employed and own-account	-2.7	1.6
5	Lower supervisory and technical	-1.6	1.3
6	Semi-routine	1.5	0.9
7	Routine	-5.0	1.7*

1. Annual decrease estimated from a simple linear regression against time for the period 2001–08
- slope is statistically significant at the 95% level

Source: ONS

The greatest annual decrease in mortality rate occurred in the Routine occupations class with a reduction of five deaths per 100,000 per year. It was followed by Higher managerial and professional occupations and Lower managerial and professional occupations, with an annual decline of around three deaths per 100,000 per annum. No other classes had a significant trend.

Table 2 and Figure 2 suggest that, for the three-class NS-SEC, Managerial and professional occupations have shown a steady decrease in mortality, while the other two groupings have experienced no significant change. This would suggest that the most advantaged experienced the greatest decline in mortality over the period 2001–08.

Inequalities

Absolute measures

Table 4 and Figure 3 present three measures of absolute inequality.

Table 4 Measures of absolute inequalities in mortality rates of NS-SEC classes by year, women aged 25–59

England and Wales — Rate per 100,000

	Absolute Difference of mortality rates[1] between 'Managerial and professional' and 'Routine and manual' class	Absolute Difference of mortality rates[1] between 'Higher managerial and professional' and the 'Routine' class	Slope Index Of Inequality
2001	112	213	182
2002	108	181	172
2003	126	223	204
2004	124	213	197
2005	120	191	189
2006	127	205	200
2007	126	195	196
2008	125	192	199

1. Mortality rates are age-standardised to the European standard population. Numerators and denominators have been adjusted as described in the article

Source: ONS

No conclusive trend is suggested by these estimates, although the three-class NS-SEC range suggests an increase in inequality. However, an increase in the range of 18 deaths per annum occurred between 2002 and 2003, which was greater than the aggregate change over the period. This volatility reduces the confidence in the existence of a trend.

Figure 3 Measures of absolute inequalities in mortality rates of NS-SEC classes by year, women aged 25–59

Index 2001=100

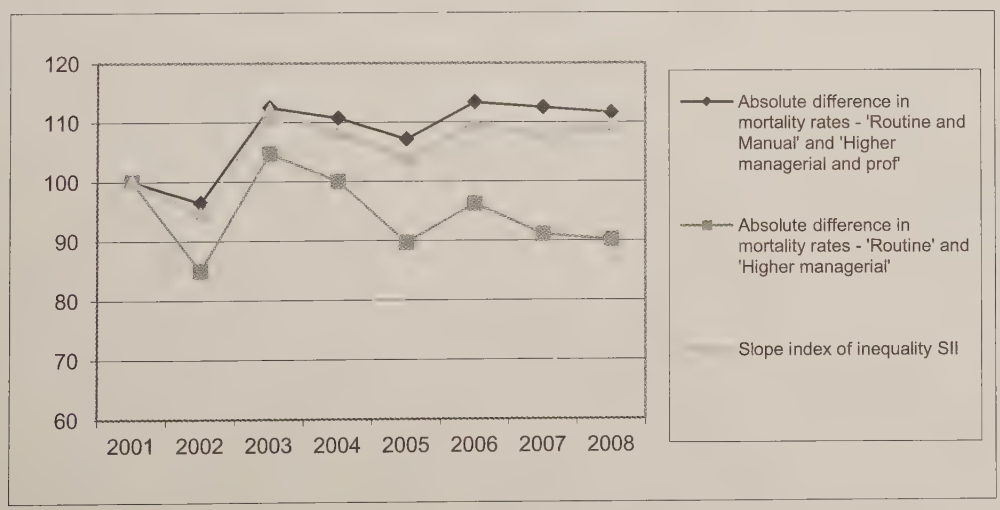


Table 5 and Figure 4 show measures of relative inequality.

Table 5 Measures of relative inequalities in mortality rates of NS-SEC classes by year, women aged 25–59

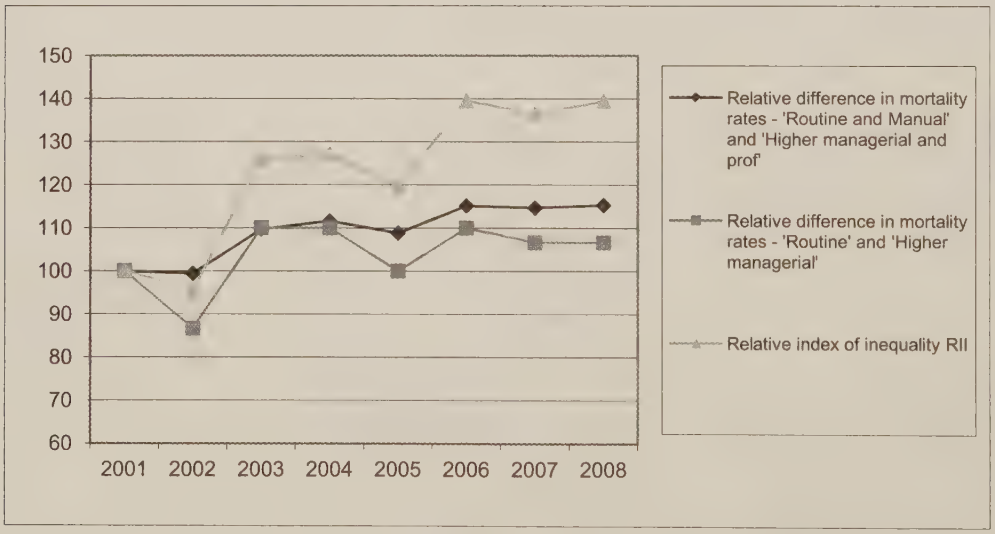
England and Wales

	Ratio of mortality rates[1] between 'Managerial and professional' and 'Routine and manual' class	Ratio of mortality rates[1] between 'Higher managerial and professional' and the 'Routine' class	Relative Index of Inequality
2001	1.9	3.0	3.3
2002	1.9	2.6	3.2
2003	2.0	3.3	4.2
2004	2.1	3.3	4.2
2005	2.0	3.0	4.0
2006	2.1	3.3	4.6
2007	2.1	3.2	4.5
2008	2.1	3.2	4.6

1. Mortality rates are age-standardised to the European standard population. Numerators and denominators have been adjusted as described in the article

Figure 4 Measures of relative inequalities in mortality rates of NS-SEC classes by year, women aged 25–59

Index 2001=100



The ratio between the Routine and Manual group and the Managerial and Professional group suggests a slight increase in relative inequality. The relative index of inequality which takes into account the intervening classes suggests a greater increase in inequality. However, neither of these indicators are strictly monotonic in their trend, which again suggests a high level of variability relative to the trend. The ratio between the seven-class Routine class and the most advantaged Higher managerial and professional class shows no trend. The sharp reduction in inequality in 2005 arises from the decreased mortality rate of the Routine NS-SEC classes in 2005 as a result of a 4 per cent decrease in deaths for this class in a single year. The authors cannot find an empirical explanation for this change.

Figure 5 Three-year simple moving averages of age-standardised mortality rates by NS-SEC, women 25–59, 2001–08

England and Wales
Rate per 100,000 person years

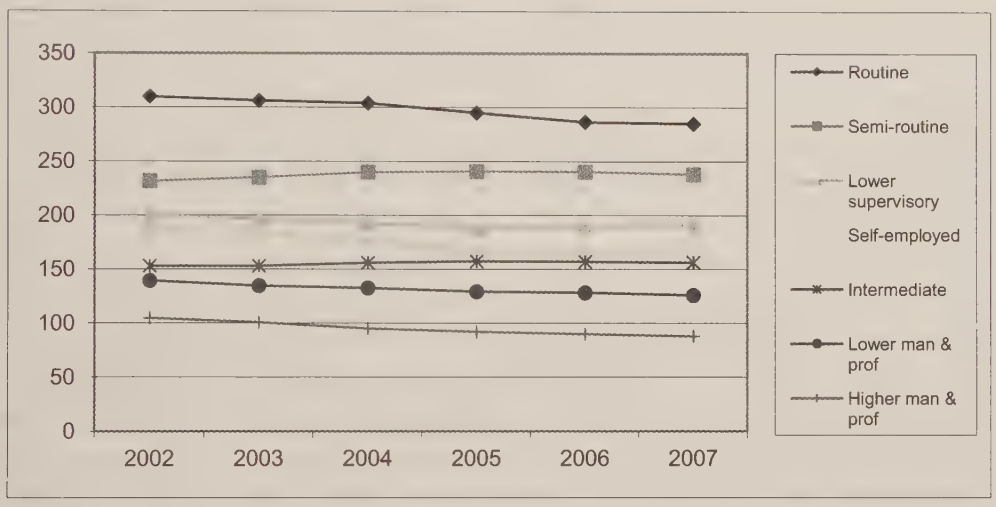


Figure 5 shows a clearer picture of trends by smoothing the annual figures to show a three-year centred moving average. It can be seen more clearly here that there is a trend toward decreased mortality for Higher and Lower managerial and professional occupations and Routine occupations. Small employers and own account workers show some sign of a decline in mortality.

An unexpected result is the apparent increase in mortality among the Semi-routine class. This is not a statistically significant result, but the relatively poor recent trend for this class is a matter for concern.

Discussion

The results suggest that, over the period 2001 to 2008, there has been a decrease in overall mortality rates for women but not for all classes. Both Higher managerial and professional and Lower managerial and professional occupations showed a steady and significant decline in mortality rates over the period 2001–08, as did Routine occupations. The intervening classes did not show any significant trend over the period.

For both absolute and relative measures of inequality, the use of the range between the extremes of the class schema, between Higher managerial and professional and Routine classes, proved too volatile to show any trend. By contrast, the more aggregated three-class condensed NS-SEC did suggest an increase in inequalities in relative terms.

The relative index of inequality also showed an increase in inequality, but the absolute index showed no discernible trend.

One of the most surprising results is the apparent rise in mortality for the Semi-routine class. The reason for this was a rise in total deaths of 5 per cent in this class for this age group, while population remained fairly static. This was compared with a fall in aggregate deaths across all classes of about 6 per cent. This increase in deaths, particularly in the upper age groups of the range, remains unexplained. A general comparison with longer-term trends in female life expectancy, (Johnson, 2011) suggested that the pattern for the most advantaged classes (Higher managers and professionals and Lower managers and professionals) was reflected in the results of the current study, with these classes experiencing the greatest growth in life expectancy over twenty years and the greatest decline in mortality between 2001 and 2006. However, there is no indication in the life expectancy estimates to suggest a poor trend performance in mortality rate for Semi-routine occupations, nor is there evidence of a greater than average recent improvement in the mortality of the Routine class, as suggested by the results from the current study. It should be remembered that life expectancy covers deaths at all ages whereas the current study focuses only on deaths at working age. For the year 2008, female deaths between age 25 and 59 constituted only 8 per cent of total female deaths above the age of 25.

Comparison with the results for men

While comparison with the results for men is complicated by the enforced omission of the age group 60–64, (where naturally a higher rate of mortality occurs than between 25 and 59), the results show some major differences to those obtained for men (Langford and Johnson, 2010).

Firstly, the overall rate of decline in mortality rate for women was less than for men (less than two deaths per 100,000 per annum compared with six deaths per 100,000 per annum for men in the age group 25–64). Women's mortality in general is much lower than men's on average at these ages, but it appears that men are 'catching up'. For men, all NS-SEC classes showed a significant trend decline in mortality over the period 2001–08. By contrast, it appears from the results presented here that the reduction in female mortality at working age is sufficiently small that the variation from year to year obscures the trend in all but the three classes referred to above.

Absolute measures of inequality were greater for men, and declining over time. For women, the absolute measures did not exhibit a discernible trend. Relative measures of inequality were of a similar magnitude and pattern for men and women. Inequality by these measures increased for both, but was slightly smaller on all measures for women. This pattern of greater absolute inequality for men but similar levels of relative inequality between the sexes has been found across developed economies (Mustard and Etches, 2003). At the very low levels of female mortality at ages studied, it is more likely that relative measures will show an increasing trend in inequality than absolute ones (Scanlan (2000), Eikemo *et al* (2009)).

Where trends for women were apparent in the current study it appears that the most advantaged have tended to improve their position compared with the other classes. The only exception is in the absolute improvement of the Routine class which showed the greatest mean reduction in mortality rate per year of all classes, as was the case for men in the earlier article.

There are a number of potential explanations which have been advanced for generally lower observed mortality differences by socio-economic class for women than for men. One is that women are exposed to fewer occupational hazards than men in the same socio-economic class (OPCS, 1978 ch 3). However, those analyses which differentiated single women using their own socio-economic classification, have found similar social gradients to those for men (Moser *et al*,1990, Koskinen S & Martelin T, 1994, Langford & Johnson, 2009), see Figure A3. It therefore seems unlikely that direct occupational hazards are a major cause of within class mortality differentials.

If the woman's class is determined by her husband using the 'combined' approach to socio-economic classification, NS-SEC is measuring only her life chances based on the assumed socio-economic location of the household. While this type of approach has been found to produce inequalities similar to those for men (Sacker A *et al*, 2006, Langford and Johnson 2009), it is to be expected that the social gradient based on this measure would be diluted by the indirect nature of the classification.

The combination of some women who were economically inactive with those who had an occupation of their own in the same NS-SEC class may further reduce the distinctiveness of class definition. If the data had permitted, it may have been found that those women who were not economically active would exhibit a higher death rate than those in the same NS-SEC class who had been assigned to that class based on their own occupation. For example, Moser *et al* (1990) found that the group of women classified as not in paid employment and married to men in manual social classes had the highest death rate of all cross-classifications of spouses, except where neither spouse was in employment.

In the current study, data for 2001 suggested that 42 per cent of female deaths were assigned to an NS-SEC class based on their own occupation, while 39 per cent were assigned based on their husband's occupation. (The remaining 19 per cent could not be assigned based on death registration data). Approximately 60 per cent of those assigned via the husband's occupation were women with no recorded occupation of their own. There was a wide variation in these percentages across classes. For example, 81 per cent of deaths assigned to the 'Intermediate' class were based on the woman's own class, while only 26 per cent of those assigned to 'Higher managerial and professional' were.

A more straightforward reason for smaller inequalities among women is that many of the causes of death with very steep social gradients, such as lower respiratory diseases and circulatory disease are more prevalent in men than women (Mackenbach *et al*, 1999, Koskinen and Martelin, 1994, White *et al*, 2008, Langford *et al*, 2009). By contrast, breast cancer mortality has a negligible social gradient.

Suitability of the LFS-based measures for monitoring health inequalities.

The corresponding study on men (Langford and Johnson, 2010), stated that 'annual trends in inequalities in mortality at the national level can be effectively monitored using LFS-based measures'. The current study has probably demonstrated the limits to this method, particularly when incremental changes from year to year are relatively small. For three out of the seven analytic NS-SEC classes, there was no statistically significant trend. More importantly, there appeared to be volatility or 'noise' from year to year which in most cases outweighed the trend effect. It must be acknowledged that detecting trends at very low levels of mortality is difficult. A recent longitudinal study of England and Wales found clear rising trends in female life expectancy for each NS-SEC class, but in individual years, life expectancy for a particular class might fall, (Johnson, 2011). Further, the LS study used all ages including the very elderly where there were much higher age-specific mortality rates. The current study focused on an age range (25–59) where the LS would have shown a similar degree of volatility from year to year (though still a clear long-term trend).

Retrospective changes in LFS populations over time through reweighting of the survey would also have a small but detectable change in estimates which would make them subject to revision. Given these qualifications it seems feasible to use the LFS-based estimates for indicators of health at national level, provided it is recognised that a figure for any given year may be an aberration.

Limitations of the analysis

Owing to the sparse recording of women's occupations at death after normal retirement age, it was necessary to restrict the analysis to women aged 25–59, accounting for only 8 per cent of the deaths of women over the age of 25.

The LFS is the main source of the population estimates that was used to produce denominators for the estimates of mortality rates presented in this article. As a survey the LFS can encounter changes due to methodological improvement and to maintain consistency of its published aggregates, and this may have effects on the presented results. Boosts to LFS sample size were introduced a number of times over the period 2001–2008, but this should not have an effect on estimates of mortality rates. It is possible, however, that changes to LFS response rates do have an effect. The response rate to the LFS changed from 69 per cent in 2001 to 60 percent in the first quarter of 2008 with high refusal rates in London and in flats and mobile accommodation (Barnes *et al*, 2008). However, the LFS weighting system should correct for this and maintain the LFS population consistent with the latest official population estimates. With the exception of 2001, the LFS weights calculated in 2010 have been used throughout this analysis and, as a result, the estimates should be consistent across time. For 2001, 2010 weights were not available, and so 2007 weights were used. Comparison of the population by NS-SEC in other years where both

sets of weights were available suggested that this would not have had a substantial effect on the results for 2001. For the years 2002 and 2003, the LFS sample for March of the year in question to February of the following year had to be used, owing to a lack of annual data from January to December for these years weighted by 2010 weights.

The combined NS-SEC was used in this article to compensate for the very sparse recording of women's occupations at death and the difficulty in. classifying women's socio-economic position based on occupation alone. There are conceptual problems with the use of a combined NS-SEC since theoretically, NS-SEC is based on the employment relations status of the individual. Using the most advantaged NS-SEC of a married couple implies the assumption that one can use the most advantaged labour force status of two marriage partners as a proxy for the life-chances of both. Naturally this is not always the case, but it is felt that this provides a more accurate classifier for most women than using simply their own occupation-based class. There may also be biases arising from the fact that some occupations have fewer men so that, for example, 'Lower technical' will more often be taken from a male partner's occupation, while 'intermediate' may more often be the woman's occupation. In addition, the NS-SEC classification at death provides only a snapshot of a woman's class location and cannot reflect the potential accumulation of advantage and disadvantage over the lifecourse.

A number of adjustments were made to the raw data during the course of the calculations.

- Following the practice of earlier studies, in particular Langford and Johnson, (2009), owing to the under-recording of occupation at death of women, adjustments were made to the numbers of deaths by NS-SEC. These adjustments were based on an analysis in an earlier study of 158 female deaths of members of the ONS Longitudinal Study who had no occupation recorded at death in the years 2001–04. It was found that approximately 70 per cent of these women had an occupation according to the 2001 Census. The percentage distribution of these 'unclassified' women across NS-SEC classes was used throughout the study and assumed to be fixed throughout. There was a smaller reallocation of NS-SEC class 3 deaths to NS-SEC class 2, since it was discovered that a substantial number of deaths inaccurately failed to note the supervisory status of the deceased (see White *et al*, 2007).

- Populations by NS-SEC were also adjusted to take account of health selection. This is where those without a recorded occupation have been selected out of the workforce for health reasons. Again, in an earlier study using the LS, a certain proportion of people of working age who did not have an occupation at the 2001 Census but did have one in 1991 were assumed to be 'selected out'. (Langford and Johnson, 2009). The proportions obtained in terms of reallocation across NS-SEC classes were the same as for the estimates obtained using 2001 Census data for population denominators. These proportional reallocations remained constant throughout the study period.

There is a case for not making adjustments, since they add to the complexity of the analysis. However, health selection effects are well known and to ignore them would invite a known bias. Because of this concern, a sensitivity analysis was carried out whereby the raw deaths and LFS population estimates by age band and NS-SEC were used to estimate mortality rates. While substantial differences occurred for particular classes in particular years, the overall pattern remained remarkably similar to those described above, and none of the observations or conclusions would have been substantively altered as a result.

Another assumption made was that those living in communal establishments and not counted by the LFS did not make a substantive difference in the distribution across NS-SEC analytic classes for women aged 25–59. This would appear reasonable, since deaths at communal establishments were less than 2 per cent of all deaths for women under age 60 and there was no identifiable pattern among analytic NS-SEC classes in the proportion of deaths which were at communal establishments.

Conclusions and Recommendations

This study has attempted to estimate the annual change in inequality in mortality rates by NS-SEC for women aged 25–59 in the period 2001–08 using the LFS to estimate populations by age band and NS-SEC. The estimates suggested that there was a statistically significant downward trend in mortality for Higher managerial and professional occupations, Lower professional and managerial occupations and for Routine occupations. Intervening classes did not exhibit a significant trend. In particular, the volatility from year to year obscured the trend for certain classes.

Both absolute and relative indicators of inequality were used. The absolute difference measures showed no discernible trend. The relative difference measures showed a slight increase in inequality, except for the range between Higher managerial and professional and Routine occupations. Routine occupations had the greatest mean reduction in mortality rates per year (approximately five deaths per 100,000 population per annum). Absolute differences in inequality were substantially less than they were for men and relative differences were slightly smaller, but of a similar magnitude.

Mortality of women aged 25–59 is very low and therefore less likely to exhibit a downward trend than deaths at older ages. This makes it difficult to identify trends. The annual volatility apparent in this data and the range of the confidence intervals of the estimates suggest that this analysis is at the limit of the capability of the LFS sample to provide population denominators by class.

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Appendix A

Health selection adjustments for LFS data

The concept of 'occupation' used to derive socio-economic class for the purpose of estimating mortality rates in successive Registrar General's decennial supplements, is that in which the person is currently engaged or most recently was engaged, if not currently employed or economically active. This is partly because using only current occupation tends to understate those who are usually employed and makes classification more subject to macroeconomic fluctuations. In addition, death registration of necessity uses a definition which extends back in time. Thus occupation in this context is not restricted to the employed or even to the economically active. Most importantly, those in the most disadvantaged classes are less likely than the more advantaged to report a former occupation if sick, and this may lead to biased estimates if not adjusted (OPCS, 1978).

In the published estimates using census-based denominators, an adjustment was made to counteract a potential selection effect brought about because some of those in poor health may have been selected out of the labour market. This adjustment was made using the ONS Longitudinal Study to estimate the proportion of those with no recorded occupation and therefore no analytic NS-SEC class in 2001, but who had a recorded occupation in 1991. The 1991 NS-SEC distribution of those in each age group unclassified at 2001 was used to redistribute population to the analytic NS-SEC classes. In order to make results using the LFS consistent with the published ones based on the census, it was necessary to imitate the adjustments undertaken on the census-based denominators using the published adjustment for those with no occupation recorded in 2001. The adjustment process first estimates the number of people which should be redistributed from the residual to the analytic classes, and then allocates to classes using the same distribution pattern as the census-based estimates.

Illustrative example of derivation of populations by age and NS-SEC using the LFS counts and ONS mid-year populations

The process of translating the raw LFS counts into population estimates comparable with the published census-based figures is shown for 2001 in Table A1.

Table A1 Raw LFS population counts by NS-SEC and steps involved in reallocating residual population, women aged 25–59, 2001

England and Wales

Thousands

	LFS population counts by NS-SEC analytic class, women, 2001								Total of analytic groups Sum (1.1–7)	ONS mid-year population[1]	Unallocated population	Proportion residual in optimised table[2]	Final residual	others for reallocating across analytic groups
	1.1	1.2	2	3	4	5	6	7	a	b	c = b - a	d	e = b x d	f = c - e
Ageband														
25–29	94	147	512	273	60	125	240	120	1571	1745	174	0.080	139	35
30–34	187	194	583	267	107	162	241	119	1860	2033	173	0.049	99	74
35–39	223	199	597	254	154	165	223	120	1935	2082	147	0.038	78	69
40–44	194	174	530	234	142	148	195	103	1720	1853	133	0.032	59	74
45–49	169	157	494	201	134	142	167	91	1555	1670	115	0.028	47	68
50–54	159	154	502	211	156	162	207	105	1656	1801	145	0.023	42	103
55–59	110	109	366	196	143	148	201	105	1378	1520	142	0.025	37	105
Total	1135	1134	3583	1636	897	1051	1474	763	11675	12705	1029		501	528

1 ONS mid-year population estimates for 2001
2 Langford A and Johnson B (2009) 'Social inequalities in adult female mortality by the National Statistics Socio-economic Classification, England and Wales, 2001–03, *Health Statistics Quarterly*,42,p6–21
3 Totals may not agree precisely with the numbers in the body of the table owing to rounding

The LFS based estimates for each NS-SEC analytic class are shown on the left-hand side of the table and the totals for each age group are shown in column a. The ONS mid-year population totals for 2001 are in column b and the difference (the 'unallocated' population), in column c.

In order to approximate the optimised estimates, it is necessary to simulate the transfer from the unallocated populations to the NS-SEC analytic classes, which was undertaken on the published census data using the health selection adjustment.

Firstly the proportion of the population in each age group which was to be assigned to the residual NS-SEC classes was set equal to that in the census-based 'optimised populations'.(column d in Table A1). These proportions were multiplied by the ONS mid-year populations to obtain the numbers in the residual categories (column e). The remainder of the unallocated population is obtained by subtracting column e from column c.

Thus for example, the number unclassified aged 25–29 in the optimised population estimates was 8 per cent of the total population Thus the population (in thousands) in the residual is 1745 x 8% = 139 (rounded to thousands). The number available for reallocation is therefore equal to the population for the age group (1745) less the NS-SEC analytic group population estimated from the LFS estimates (1571) less 139 (equals 35).

The resultant population is then reallocated across NS-SEC classes according to the proportions estimated from the gain in person-years by each NS-SEC analytic group from the health selection adjustment in the published study using census-based denominators, (Langford and Johnson (2009), Social Inequalities in adult female mortality by NS-SEC, England and Wales, 2001–03, Health Statistics Quarterly, No. 42. Table A2 shows these revised population counts.

Table A2 Revised population counts by NS-SEC after adjustments, women aged 25–59, 2001

England and Wales — Thousands

	LFS population counts by NS-SEC analytic class									
	1.1	1.2	2	3	4	5	6	7	Residual[1]	Total Population[2]
25–29	94	147	513	282	59	126	256	130	139	1745
30–34	187	194	586	282	105	164	274	143	99	2033
35–39	224	200	601	269	154	168	248	141	78	2082
40–44	196	175	536	250	142	150	220	125	59	1853
45–49	171	157	505	215	137	145	185	109	47	1670
50–54	162	156	522	243	161	161	229	124	42	1801
55–59	110	109	387	222	146	148	234	126	37	1520
Total	1144	1138	3650	1763	904	1062	1646	898	501	12705

1 As per Table A1
2 ONS mid-year population estimates for 2001, as per Table A1
3 The effect of rounding will mean that some totals are not a precise sum of the figures shown

Table A3 2001–08 Study number of deaths by combined[1] NS-SEC classification, women aged 25–59

England and Wales

	NS-SEC analytic classes									
Year	1.1	1.2	2	3	4	5	6	7	Unoccupied[2]	Total
2001	930	1136	4439	2422	1688	1910	2844	2291	4070	21730
2002	1066	1201	4382	2319	1761	1818	2919	2077	4096	21639
2003	991	1090	4412	2456	1767	1736	2984	2156	4337	21929
2004	931	1177	4384	2398	1564	1684	2912	1956	4223	21229
2005	928	1188	4396	2450	1503	1526	3035	1874	4354	21254
2006	938	1136	4298	2397	1477	1426	3060	1910	4309	20951
2007	930	1167	4374	2330	1411	1619	2977	1790	3889	20487
2008	964	1109	4203	2315	1532	1423	3000	1728	4216	20490
Total	7678	9204	34888	19087	12703	13142	23731	15782	33494	169709

1 A combined classification where the most advantaged of the women's NS-SEC class and that of her husband was used. If a woman was not married then her own classification was used.
2 Including never worked, long term unemployed, full time students, occupations inadequately described, not classifiable for other reasons.

Table A4 2001–08 LFS Study populations (person years at risk) by combined[1] NS-SEC classification, women aged 25–59

England and Wales — Thousands

	NS-SEC analytic classes									
Year	1.1	1.2	2	3	4	5	6	7	Unoccupied[2]	Total
2001	1135	1134	3583	1636	897	1051	1474	763	987	12661
2002	1205	1120	3629	1643	861	1024	1475	749	993	12700
2003	1228	1176	3698	1628	880	970	1416	703	1015	12714
2004	1271	1213	3731	1588	885	952	1417	684	1021	12762
2005	1281	1223	3766	1579	881	944	1394	676	1044	12788
2006	1283	1285	3785	1538	870	912	1404	672	1092	12841
2007	1300	1300	3801	1520	853	888	1431	661	1057	12812
2008	1310	1301	3745	1526	839	865	1467	670	1068	12789
Total	10013	9752	29738	12657	6967	7606	11479	5577	8277	102067

1 A combined classification where the most advantaged of the women's NS-SEC class and that of her husband was used. If a woman was not married then her own classification was used.
2 Including never worked, long term unemployed, full time students, occupations inadequately described, not classifiable for other reasons.

The effect of lengthening Life Expectancy on future pension and Long-Term Care expenditure in England, 2007 to 2032

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Abstract

Background

The aim of this analysis is to examine the effect of different assumptions about future trends in life expectancy (LE) on the sustainability of the pensions and long-term care (LTC) systems. The context is the continuing debate in England about the reform of state pensions and the reform of the system for financing care and support.

Methods

Macro and micro simulation models are used to make projections of future public expenditure on LTC services for older people and on state pensions and related benefits, making alternative assumptions on increases in future LE. The projections cover the period 2007 to 2032 and relate to England.

Results

Results are presented for a base case and for specified variants to the base case. The base case assumes that the number of older people by age and gender rises in line with the Office for National Statistics' principal 2006-based population projection for England. It also assumes no change in disability rates, no changes in patterns of care, no changes in policy and rises in unit care costs and real average earnings by 2 per cent per year. Under these assumptions public expenditure on pensions and related benefits is projected to rise from 4.7 per cent of Gross Domestic Product (GDP) in 2007 to 6.2 per cent of GDP in 2032 and public expenditure on LTC from 0.9 per cent of GDP in 2007 to 1.6 per cent of GDP in 2032. Under a very high LE variant to the GAD principal projection, however, public expenditure on pensions and related benefits is projected to reach 6.8 per cent of GDP in 2032 and public expenditure on LTC 1.7 per cent of GDP in 2032.

Conclusions

Policymakers developing reform proposals need to recognise that, since future LE is inevitably uncertain and since variant assumptions about future LE significantly affect expenditure projections, there is a degree of uncertainty about the likely impact of demographic pressures on future public expenditure on pensions and LTC.

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Introduction

As their populations age, countries across the developed world are recognising the need to reconsider and reform their policies for older people, driven in large part by concerns over their future affordability and sustainability in the face of rising demand and increasing dependency ratios (the ratio of the non-working age population to the working age population). In England (and the UK more generally), recent debate has focused on the reform of the pensions and long-term care (LTC) systems. Whilst several reforms for pensions have been announced and legislated for, few have so far been enacted for LTC. Changes to the system for funding LTC are now expected following the publication in July 2011 of the report of the Commission on Funding of Care and Support (CFCS 2011) although it is not known yet whether the Commission's recommendations will be implemented. Despite the interconnectedness of the pensions and LTC systems, the debates concerning reform and the analysis of the reforms have so far taken place independently.

To develop reforms and analyse their effects, as well as plan and budget for the future, the UK Government and policy analysts have relied significantly on projection models, which, based on a series of documented assumptions, attempt to demonstrate the short and long-term effects and costs of different policies (Pensions Commission 2006; Wanless 2006; Her Majesty's Government 2010; CFCS 2011; Office for Budgetary Responsibility 2011; European Commission and Economic Policy Committee 2009). Underlying these models are projections of numbers of older people in years to come since this is a key driver of demand and expenditure on both pensions and LTC. The former because pensions are guaranteed to be paid to people for as long as they live, so that, subject to the impact of increases in the state pension age (SPA), increasing life expectancy (LE) means pensions are paid for longer terms. The latter because increasing LE also increases the number of years in poor health (unless all the years of LE gained are healthy years, which is unlikely to be the case (Jagger *et al.*, 2007; Donald *et al.,* 2010)), and the prevalence of disabling conditions many of which, such as dementia, are strongly related to old age (Organisation for Economic Cooperation and Development 2005; Jagger *et al.,* 2009). The accuracy of the models is therefore highly dependent on the accuracy of the projections of numbers of older people.

For forecasting numbers of older people, the key factor is the levels of mortality experienced in years to come by those who are already in - or will enter - that age group, since the only other relevant factor, migration, is low at these ages. The main source of such forecasts for England is the Government's official population projections[1]. The level of mortality in a particular year across all ages is usually summarised by the indicator of period life expectancy (LE), the average number of additional years that a group of people would live if they experienced these levels of mortality for the rest of their lives. We also follow the convention that period LE is used, for example in ONS projections publications (e.g. ONS, 2010, Chapter 9), to summarise the level of mortality. However, in our modelling, we use the relevant detailed projected level of mortality at each age for each year. Period LE has increased steadily for more than 150 years and in a largely linear fashion

[1] See for example the national population projections, series pp2 produced by the Office for National Statistics (ONS). Analyses in this paper were undertaken using the 2006-based official population projections. The 2008-based projections had similar assumptions (ONS, 2010. p. 24). The 2010-based projections were published in October 2011 (available at http://www.ons.gov.uk/ons/rel/npp/national-population-projections/2010-based-projections/index.html). These later sets could not be included in the analyses, but the projected figures are very similar to the earlier sets; for example, the projected numbers aged 85 and over in England and Wales in 2031 differ by less than 1 per cent between the 2006 and 2010-based projections (Table 1), so the main conclusions of the paper are not affected.

over the last forty years. However, the projections made during this latter period have assumed that there would be a reduction in the observed rates of improvement in the years ahead of the base, sometimes assuming no further improvement in the longer term. The consequence is that LE has been consistently under-projected, leading to substantially lower numbers of older people, especially among the 'oldest old', those aged 85 and over (Murphy 1995; Keilman 2007; Shaw 2007). Under-projection of this kind can have serious consequences for analysing the effects, sustainability and future affordability of both pensions and LTC systems.

It is therefore important to recognise the limitations of the population projections and at the same time produce policy that is robust to such uncertainty. For this reason, it is common to produce a range of alternative projections for future years rather than a single set and this is the approach taken by the Government Actuary's Department (GAD) and more recently the Office of National Statistics (ONS) in the official population projections.[2] To aid users the most plausible projection set is indicated and conventionally denoted as the principal variant (Office for National Statistics 2009: 8). The variants are frequently presented as plausible alternatives to the principal projection. The sensitivity of policy to changes in the assumptions on future trends in LE provides useful information to policymakers to ensure that their plans are robust to this uncertainty, although these variants do not have explicit probabilities of likelihood of occurrence attached to them (Abel *et al.,* 2010).

The choice of the principal and variant projections is therefore important. The poor past performance of the principal projection, in the sense that it has consistently under-projected improvements in LE, also undermined the usefulness of the variant projections, since they have not adequately captured the 'funnel of doubt' associated with the principal projection. The Pensions Commission (2005) argued that at the time, the low LE variant was considered implausible by most experts, whereas this was not the case for the high LE variant. In recent years, ONS have upwardly revised mortality improvement such that the official projections now assume that overall mortality improvement in the future will be comparable to that actually experienced over corresponding periods in the past (Office for National Statistics 2009: 8). This means that, for example, the projected numbers of men aged 85 and over in 2031 in England and Wales is over twice as many in the 2008-based principal projection than projections made 14 years earlier, with over half a million more older men and women expected (Table 1). However, questions remain about the likely evolution of future trends in LE and in this context the plausibility of the current set of official projections and therefore the ability of the variants to support robust policy decisions.

[2] Population projections were previously undertaken by the GAD but transferred to ONS in 2006.

Table 1 Past performance: Projected number of people aged 85 and over, Principal Projection, England and Wales

Thousands

	Base year for projections							
	1994	1998	2000	2002	2004	2006	2008	2010
Males								
Base year value	228	269	286	285	293	344	383	418
Projection for 2031	552	691	722	885	933	1086	1113	1071
Females								
Base year value	689	748	768	728	709	778	823	856
Projection for 2031	1040	1130	1116	1352	1342	1483	1549	1518

Source: M Murphy from ONS Series PP2 and Populations Projections Reports (various)

Using projection models of LTC and pensions, the aim of this paper is to examine the effect of different assumptions about future trends in LE on the sustainability and affordability of both the pensions and LTC systems, and, given the potential for reform of the LTC system, the effect under a selected LTC reform proposal. The focus is on providing estimates of the total likely future cost to the public purse, although we also present estimates of the likely income from private pensions and private expenditure on LTC. We do not consider here how costs would be financed. By considering the effect of future trends in LE on the pensions and LTC systems together, we also take a first step in drawing these debates together. Before presenting evidence from the projection models, we first consider how LE trends may develop in future years and provide some background to the pensions system, which is the same throughout the UK, the LTC system as it operates in England and the models used for projecting future expenditure.

Background

Future trends in life expectancy

There are sharply divergent views about how trends in LE may develop during this century: for example Christensen *et al.* (2009: 1139) pointed out "If the pace of increase in life expectancy in developed countries over the past two centuries continues through the 21st century, most babies born since 2000 in [countries] with long life expectancies will celebrate their 100th birthdays. … research suggests that ageing processes are modifiable and that people are living longer without severe disability". On the other hand, Olshansky *et al.* (2005: 1142) stated: "as a result of the substantial rise in the prevalence of obesity and its life-shortening complications such as diabetes, LE at birth and at older ages could level off or even decline within the first half of this century".

At present, overall age standardised mortality rates (both sexes combined) are improving at about 2.5 per cent per annum in England and Wales, but current trends are heavily influenced by patterns at ages where deaths are concentrated. In 2005, just over 50 per cent of deaths in England and Wales occurred to people born in the period around 1925 to1945. These birth cohorts, sometimes referred to as the 'Golden generations' have exhibited faster-than-average rates of mortality improvement in recent decades (Dunnell 2008: 19). Current British official mortality projections are based on the assumption that this group will enjoy advantages in future up

to the highest ages (Office of Population Censuses and Surveys 1995; Office for National Statistics 2009). Thus the high levels of mortality improvement observed in recent years are assumed to be a transient phenomenon largely associated with those born around the period 1925–45 and that as these cohorts are replaced in the main mortality age groups by less favoured cohorts, rates of mortality improvement will fall in future. Current official projections assume that mortality improvement will decline to a value of about 1 per cent per annum in about 25 years time after the 'Golden generations' effect has worked itself out of the system. However, although the phenomenon of the 'Golden generations' was identified two decades ago, no clear-cut causal mechanisms have been established, and therefore the extent to which the current high annual rate of improvement is directly related to these cohorts or alternatively, whether it is a more generalised period phenomenon is contested. Future prospects are likely to depend on a number of factors, especially the obesity epidemic identified by Olshansky *et al.* above. However, the Government Office for Science (2007) recently concluded that any increase in obesity will have surprisingly little impact (less than a year) on the LE of the population, in a period when official projections assume that LE will rise in the next 50 years by around eight years for men and seven years for women. While obesity has a substantial impact on morbidity status, it is unlikely to have much impact on numbers of older people in the next quarter century or so, and in any case there will be offsetting factors such as lower levels of smoking among later cohorts (see for example Murphy and Di Cesare 2012 (forthcoming)).

Official projections in all countries take different views on future trends. Although British official projected increases in LE assume that current rates of improvement will decrease substantially in future decades, nevertheless they are among the most optimistic in the developed world, so that by 2030 LE in the United Kingdom is expected to be about four years greater than in the US, at which point US values for both sexes combined would only be about the same as current UK values (Table 2).

Table 2 Comparison of Projected Life Expectancy, UK & USA 2008 Official Principal Projections

Years

	Additional years of LE from 2010		
	2010	**2020**	**2030**
Males			
US	75.7	1.3	2.7
UK	78.5	2.7	4.3
Females			
US	80.8	1.2	2.3
UK	82.4	2.4	4.2

Source: http://www.census.gov/population/www/projections/2008projections.html and http://www.ons.gov.uk/ons/rel/lifetables/period-and-cohort-life-expectancy-tables/2008-based/index.html

Pension policy in the UK

In the UK, the state retirement pension is payable to people who have reached SPA and have made, or been credited with, sufficient National Insurance Contributions. There are two main

components of the current state pension. The first is the basic state pension (BSP) which is unrelated to earnings. The second is an additional earnings-related pension. The formula through which this additional pension is related to earnings has changed over time. Non state pensions are an important component of the UK pension system. They include employer-based schemes and pensions arranged by individuals. It is possible to 'contract out' of the earnings-related component of the state pension by making contributions to an appropriate employer or individual pension. Means-tested state benefits exist to supplement the incomes of low income pensioners. Pension Credit (PC) is a general income supplement. Housing Benefit provides help towards paying rent. Council Tax Benefit reduces liability for the local property-based Council Tax.[3] Changes in LE affect spending on state pensions mainly through their effects on the numbers of people over SPA rather than for example, through the age composition of the older population as there are only minor age-related supplements to pensions.

Following the report of the Pensions Commission (2005) and the *2007 Pensions Act*, a number of reforms to UK pensions are in train. They address concerns over the long-term affordability of state pensions in the face of rising longevity and the inadequacy of pensions and substantial reliance on means-tested supplements among some groups. Pension inadequacy has been fuelled in part by the falls in the proportion of employees contributing to non-state pensions, the trend away from defined benefit (DB, 'final salary') pension schemes towards defined contribution (DC) schemes and insufficient private pension contributions by those on low to middle earnings. The key changes now coming into force include: a rise in the SPA to 66 by 2026, 67 by 2036 and 68 by 2046; changes to the qualifying conditions for the BSP so that more people will qualify for the full amount and a commitment to link annual increases in the BSP to earnings rather than prices; measures to limit the spread of means-tested benefits especially PC; and the introduction of a new low costs national pension savings scheme (NEST) which requires employers to enrol eligible employees automatically into a work-based pension scheme, with minimum employee and employer contributions, unless the employee explicitly opts out. The pension projections in this paper use these policies as the basis for projection.

The Coalition Government has recently introduced legislation in the *Pensions Act 2011* to bring forward the increase in SPA so that SPA becomes 65 for women by 2018 and 66 for men and women by 2020. It has also changed the basis of indexation of pensions in payment for state pensions; SERPS and state second pension (S2P) benefits in payment will in future be increased in line with the Consumer Prices Index (CPI) rather than the Retail Prices Index (RPI), and the Government also intends to in future provide a 'triple guarantee' to increase the BSP each year by the highest of consumer price inflation, earnings rises or 2.5 per cent (HM Treasury 2010), as opposed to the previous policy of earnings indexation from 2012. The Government has also started a consultation process considering more radical reform of the state pension system (Department for Work and Pensions 2011).

Long-term care policy in England

LTC is generally considered to mean help with nursing tasks, personal care tasks such as dressing and bathing, help with domestic tasks such as shopping and preparing meals, and nursing care

[3] There are also non means-tested benefits for pensioners with significant disabilities. In this paper we treat the component of these that are used to fund LTC as LTC expenditure.

(Comas-Herrera *et al.*, 2004). Public support for all LTC (except the nursing element of care) in England is both needs and means-tested. For residential services in nursing and residential care homes, the means test takes into account the income and assets (in most cases including any housing wealth) of residents. Those with assets over an upper limit, £23,250 in 2011/12, are not eligible for public support with the costs of care. Those with assets below this level are required to pay some of the costs of their care, the amount depending mainly on their income. Local authorities (LAs) have discretion over how they charge for community-based care services such as home care, although there are national guidelines which set out common principles to which LAs must adhere in determining how much to charge users (Department of Health 2003). The needs tests are also carried out by LAs, although there are national guidelines, which set out principles that LAs should take into consideration (Department of Health 2010).

Sustained debate over the past decade or so has produced a number of proposals for reform, which all present more universal systems. Thus a Royal Commission on LTC suggested a policy of 'free' personal care (Royal Commission on Long-term Care 1999); the Wanless Social Care Review (Wanless 2006) suggested a 'partnership' scheme, which was recommended by the Labour Government's Green Paper (Her Majesty's Government 2009) and marked for consideration in the terms of reference of the Coalition's Commission on the Funding of Care and Support (Secretary of State for Health 2010); and the International Longevity Centre suggested a national insurance approach (Lloyd 2008). In the lead up to the 2010 election, the debate around LTC intensified and the then Labour government proposed a National Care Service, mirroring the National Health Service, and creating a fully universal care system for LTC (HM Government 2010).

A stumbling block, however, in proposals for all of these reform options is how they should be funded, with concerns over the future affordability and sustainability of the options. The Royal Commission proposed funding free personal care through general taxation but, although this was adopted in Scotland, it was rejected in England on grounds of affordability (Department of Health 2000). Unable to decide on how best to raise funds for the National Care Service, the Labour government proposed setting up a Commission (Her Majesty's Government 2010). The Coalition Government established the Commission on Funding Care and Support (CFCS), whose terms of reference stated the need to make recommendations for an affordable and sustainable funding system (Secretary of State for Health 2010). The Commission reported in July 2011. Its main recommendation was that individuals' lifetime contributions towards their social care costs - which are currently potentially unlimited - should be capped. After the cap is reached, individuals would be eligible for full state support. The commission recommended that this cap should be between £25,000 and £50,000, with £35,000 considered to be the most appropriate and fair figure.

Method

To explore the effect of LE on expenditure of LTC and pensions in England over the period 2007 to 2032 we use simulation modelling techniques. More specifically we have a suite of several models which are linked in two different ways: the models share parameters, so they are based on the same assumptions, and the output from one model is used as input to another model.

To project expenditure on LTC, we use two models: the CARESIM micro-simulation model and the Personal Social Services Research Unit (PSSRU) aggregate LTC finance model. The PSSRU model is cell-based: it divides the current and projected future population into a large number of sub-groups or 'cells'. It simulates future demand for LTC and disability benefits for each of these groups, based on analysis of a sample of older people from the 2001 General Household Survey (GHS)[4]. Adjustments are made to the GHS analysis to include the residential care population and to reflect changes in the targeting of publicly-funded care provision since 2001 (Wittenberg *et al.,* 2006). CARESIM simulates the incomes and assets of future cohorts of older people and their ability to contribute towards care home fees or the costs of home-based care, should such care be needed (Hancock *et al.,* 2003). It is based on a pooled sample of older people from the 2002/3, 2003/4 and 2004/5 rounds of the Family Resources Survey (FRS) with money values uprated to the base year (here 2007) [5]. Together these two models can be used to project future expenditure on LTC by source of expenditure, under different funding reform options.

The PSSRU model output on the characteristics of people requiring LTC is used as input to CARESIM to adjust the FRS sample to be representative of people receiving different LTC services in the projection year. CARESIM then simulates for each type of service the ability of older people to contribute to their care costs and the source of income used to pay for care. CARESIM output is used to break down expenditure in the PSSRU model into its constituent components and funding sources, i.e. NHS, Personal Social Services, social security disability benefits and private money (Hancock *et al.,* 2007). The projected levels of expenditure by each of these sources are compared with projected economic output, Gross Domestic Product (GDP).[6] Therefore, using the input from CARESIM, the PSSRU model can be used to make projections both of the future balance between public and private expenditure on LTC and of the sustainability of the system with respect to economic growth measured through GDP. In addition CARESIM can be used to explore the distributional implications of policies, although in this paper our focus is on aggregate results.

Expenditure on pensions is projected using the Pension Policy Institute's (PPI) aggregate model (Steventon 2005). Outputs from this model include projections of government expenditure on pensions and of the private pension system. The model is cell-based. At its heart is a projection of the labour market in terms of the number of employees and self-employed people in each future year, by age, gender and their earnings band. Future expenditure on the earnings-related components of the state pension is estimated based on the projection of the labour market. BSP is projected by 'ageing' the existing generation of pensioners and simulating entitlements of future generations making assumptions on how entitlements are likely to change over time given current and planned changes to policy. Flows into and out of non-state pension schemes, and the associated cost of tax relief on contributions to them, are projected distinguishing a number of

[4] The 2001 GHS data are used since these are still the most detailed source of data on social care service receipt. Subsequent GHS/General Lifestyle Surveys did not collect data on service receipt and levels of disability. These data were also not available from other sources.

[5] The PSSRU model output that is used to adjust CARESIM output to be representative of the population receiving care also adjusts the relevant demographic composition of the FRS sample used in CARESIM to the projection year.

[6] Short-term GDP and cash deflators based on 30th November 2008 estimates. Long term GDP projections are based on 2008 budget report (HM Treasury 2008). The choice of GDP projections reflects the timing of the model revisions.

different types of pensions, for example funded and unfunded, DB and DC employer-based schemes and personal pensions and the new NEST.

To project the income and assets of future older people, CARESIM simulates the future evolution of income from pensions for current generations of pensioners. The PPI pension models and CARESIM are not linked in any formal way but the policy assumptions on the evolution of state pension and means-tested benefit income are the same in the two models, ensuring consistency with each other.

The PPI pension model is UK based whereas the LTC projections presented in this paper are for England. Total public expenditure across the two sectors as a proportion of GDP is estimated as the sum of the projected share of GDP spent on publicly-funded LTC in England and the projected share of GDP spent on state pensions in the UK. The result gives an indication of the combined cost to the state of pensions and LTC but is an approximation, to the extent that there may be differences between England and the UK in the underlying proportions.

Model assumptions

The simulation models use a number of assumptions about the evolution of future trends in the socio-demographic and economic drivers of (demand and) expenditure for LTC and pensions, and the evolution of LTC and pensions policy. A set of assumptions is chosen as the 'base case'. For the socio-demographic and economic drivers these represent our best guess based on our knowledge of the literature and experience. For the evolution of policy we implement only legislated-for changes and do not make any assumptions about how policy may change, for example, in response to demographic changes or changes in government. The base case assumptions are shown in Box 1.

Box 1 Key assumptions of the base case

- The number of people by age and gender changes in line with the GAD 2006-based principal population projections for England (for LTC) or UK (for pensions).
- Marital status changes in line with GAD 2006-based marital status and cohabitation projections for England and Wales.
- Prevalence rates of disability by age and gender remain unchanged, as reported in the 2001/2 GHS for Great Britain for household population (and assuming that all those in care homes are disabled).
- Home-ownership rates, as reported in the pooled 2003/4, 2004/5 and 2005/6 FRS, change in line with projections produced by the CARESIM model.
- The proportions of older people receiving informal care, formal community care services, residential care services and disability benefits remain constant by age, disability and other needs-related characteristics.
- Health and social care unit costs rise by 2 per cent per year in real terms (but non-staff revenue costs remain constant in real terms). Average earnings increase by 2 per cent per year in real terms. Real GDP rises in line with 2008 HM Treasury assumptions.
- The supply of formal LTC will adjust to match demand and demand will be no more constrained by supply in the future than in the base year.
- The LTC funding system remains unchanged as the current system for England.
- State pensions and means-tested benefits for pensioners follow policy as it was before the recent Coalition Government changes currently going through Parliament i.e. the BSP is uprated in line with earnings from 2012, the Guarantee Credit level in PC, Housing and Council Tax Benefit is linked to assumed earnings growth, as is the savings credit threshold until 2014 after which it is linked to price inflation as measured by the Retail Price Index.
- A number of assumptions have been made concerning private pensions, including the introduction of eligible individuals auto-enrolment into workplace pension schemes from 2012. It is assumed that approximately one-third of eligible employees opt-out after being auto-enrolled, and that employers who already offer pension provision will change the basis of their schemes in line with survey evidence. It is also assumed that the shift in pension provision in the private sector from DB to DC continues, with 80 per cent of the members in DB schemes in the private sector switching to DC schemes by 2020. Further details of the full range of assumptions made concerning private pension provision can be found in other PPI publications (for example PPI 2007)
- Future entitlement to state benefits is assumed to rise, following the reduction of the required number of years for full benefit to 30 years and the conversion of 'Home Responsibilities Protection' into National Insurance credits.

Variant life expectancy assumptions

In the case of official projections, the 2006-based principal variant assumes a 1 per cent underlying rate of improvement in mortality, so that at most ages annual mortality improvement rates will be 1 per cent per year by 2031 and will continue at that rate of improvement thereafter. However, for those born between 1923 and 1940, rates of annual improvement are assumed to remain consistently higher with a peak value of 2.5 per cent per year from 2031 for those born in 1931.

The official projections include two LE variants – a low and high variant – with underlying 0 per cent and 2 per cent per year improvements in mortality, respectively, with the same additional improvement as in the principal projection for those born in the period 1923 to 1940. These variant assumptions are "intended as plausible alternatives [to the principal assumptions] and not to represent upper or lower limits for future demographic behaviour" (Office for National Statistics 2010: 89). Given the high rates of mortality improvement seen in the 'Golden Generations', an underlying 3 per cent per annum rate of improvement in mortality does not seem implausible. For this reason we have also included a 'very high' LE variant, with an underlying rate of improvement in mortality of 3 per cent per annum. This model assumes that the accelerating rate of mortality improvement experienced in recent decades will continue but then stabilise at an annual rate just above the current rate of improvement of about 2.5 per cent per annum. The assumption that cohorts born around 1930 will maintain an advantage over surrounding cohorts is retained since there are both empirical and theoretical grounds to expect those born before or at the time of the First World War to be relatively disadvantaged at older ages (Murphy 2009). While these assumptions are optimistic, they do not appear to be less plausible than the assumption that mortality improvement will essentially cease in about two decades time, as in the present low LE variant.

Although it is well-known that lower socioeconomic groups have shorter life expectancies than those in higher socioeconomic groups (Office for National Statistics; Marmot *et al.*, 2010), no allowance is made for the effect that that this may have on LTC and pension expenditure. Improvements in LE are assumed to affect all population groups equally rather than, for example, benefiting those on higher incomes more than the less well-off (Nazroo *et al.*, 2008), as there are no projections of LE by socio-economic status.

Variant long-term care policy assumptions

In order to illustrate the effects of a LTC funding system in which the state meets some of the costs of care without a means test, we chose to model a version of the 'partnership' scheme. Under a partnership scheme, everyone who qualifies for care and support on the basis of their care needs would be entitled to have a set proportion of their basic care and support costs met by the state. Under a cap as recommended by the CFCS, everyone who qualifies for care would be entitled to free care after their contribution to their care costs had reached a prescribed cap. The costs of either of these reform proposals would depend on the details of the scheme, so that they could potentially have similar costs to public funds depending on the specifics of the schemes.

The version of the partnership scheme modelled here is based on the previous Government's Green Paper specification, where the state meets a third of the care costs (Her Majesty's Government 2009). We assume that all those who qualify for care are eligible to have one-third of their personal care costs met by the state. We thus interpret 'care and support' costs as meaning only personal care, which is consistent with much of the recent debate and the policy of free personal care which operates in Scotland. Labour's Green Paper, like the Wanless Social Care Review, proposed a progressive element to the scheme, such that those with fewer means receive more support to meet the costs of their care. To model the progressive element, we assume those people who are entitled to a state contribution of more than one-third of the costs of their assessed care needs under the current funding system would be entitled to the same level of state support under the partnership scheme.

We do not explore here an increase in demand arising from this policy. Eligibility for care and support, however defined, is determined according to the pattern of receipt of privately-and publicly-funded home care under the current system (and the proportion of home care that is for personal care tasks under the partnership scheme). Greater availability of state funding could change behaviour leading to more people coming forward for formal services and larger care packages. Increased demand could come from people currently outside the system managing on their own or managing with the support of family and friends.

Results

Assuming LE grows in line with the principal ONS population projections, the numbers of people aged 65 or over will rise by 64 per cent over the period from 2007 to 2032 from roughly 8 million to 13.4 million. However, as Table 3 shows depending on the variant chosen the increase in numbers of people over the period could be anywhere between 59 and 75 per cent, a difference of 1.4 million older people. The 'oldest old' age group, people over 85 is anticipated to grow the fastest, by 136 per cent under the principal projection. Uncertainty in the projections is greatest at the oldest ages, when the need for care is greatest. Thus the actual increase over the period could be anywhere between 114 and 181 per cent, a difference of around 0.75 million people.

Table 3 Projected numbers of older people, England 2007 to 2032, under four variant life expectancy assumptions

millions

		2007	2012	2017	2022	2027	2032	percentage change 2007-2032
LLE	all 65 and over	8.16	9.01	9.97	10.77	11.80	12.93	59
	all 85 and over	1.10	1.23	1.40	1.63	1.89	2.34	114
PLE	all 65 and over	8.16	9.05	10.05	10.94	12.08	13.39	64
	all 85 and over	1.10	1.25	1.44	1.70	2.03	2.58	136
HLE	all 65 and over	8.16	9.09	10.14	11.09	12.36	13.85	70
	all 85 and over	1.10	1.26	1.48	1.78	2.17	2.83	158
VHLE	all 65 and over	8.16	9.13	10.23	11.26	12.65	14.31	75
	all 85 and over	1.10	1.28	1.52	1.86	2.32	3.08	181

1 LLE low life expectancy variant, PLE principal life expectancy projection, HLE high life expectancy variant, VHLE very high life expectancy variant

Source: ONS 2006-based population projections, & VHLE projections prepared by M Murphy

Future pension expenditure

Sensitivity to changes in life expectancy assumptions

As table 4a and b show, improvements in mortality will increase state spending on pensions and related benefits using our stated assumptions on state pensions policy. Under the principal LE assumption, such spending is projected to increase from 4.7 per cent of GDP in 2007 to 6.2 per cent by 2032. Should mortality rates decline faster than under the principal LE assumption then state spending will increase more, potentially reaching 6.8 per cent of GDP under the very high LE assumption by 2032.

Table 4a Pension expenditure, by expenditure source under variant life expectancy assumptions from 2007 to 2032, England (per cent of GDP). Annuity providers do not change their rates to reflect changes in life expectancy

Percentage

		2007	2012	2017	2022*	2027	2032
	State	4.7	4.8	5.1	5.3	5.5	6.2
	Private	5.8	6.1	6.3	6.2	6.0	5.9
PLE	**Total**	**10.6**	**11.0**	**11.3**	**11.5**	**11.5**	**12.1**
	State	4.8	4.9	5.2	5.4	5.7	6.4
	Private	5.8	6.2	6.3	6.2	6.1	6.0
HLE	**Total**	**10.6**	**11.1**	**11.4**	**11.7**	**11.8**	**12.4**
	State	5.0	5.1	5.4	5.7	6.0	6.8
	Private	5.8	6.2	6.3	6.3	6.2	6.2
VHLE	**Total**	**10.8**	**11.3**	**11.7**	**12.0**	**12.2**	**13.0**

1 PLE principal life expectancy projection, HLE high life expectancy variant, VHLE very high life expectancy variant
2 State Provision includes Basic State Pension, Additional State Pension, Pension Credit, Housing Benefit and Council Tax Benefit
3 Private Provision includes workplace pensions, both private and public sector and individual pension provision.
* Projections are based on the assumption that SPA is 65 in 2022. Changes to legislation since this modelling took place now mean SPA will be 66.
Source: ONS PPI model estimates

Table 4b Pension expenditure, by expenditure source under variant life expectancy assumptions from 2007 to 2032, England (per cent of GDP). Annuity providers change their rates to reflect changes in life expectancy

Percentage

		2007	2012	2017	2022*	2027	2032
	State	4.7	4.8	5.1	5.3	5.5	6.2
	Private	5.8	6.1	6.3	6.2	6.0	5.9
PLE	**Total**	**10.6**	**11.0**	**11.3**	**11.5**	**11.5**	**12.1**
	State	4.8	4.9	5.2	5.4	5.7	6.4
	Private	5.8	6.1	6.2	6.2	6.1	5.9
HLE	**Total**	**10.6**	**11.0**	**11.4**	**11.6**	**11.8**	**12.4**
	State	5.0	5.1	5.4	5.7	6.0	6.8
	Private	5.8	6.1	6.3	6.2	6.1	6.0
VHLE	**Total**	**10.8**	**11.3**	**11.7**	**11.9**	**12.1**	**12.8**

1 PLE principal life expectancy projection, HLE high life expectancy variant, VHLE very high life expectancy variant
2 State Provision includes Basic State Pension, Additional State Pension, Pension Credit, Housing Benefit and Council Tax Benefit
3 Private Provision includes workplace pensions, both private and public sector and individual pension provision.
* Projections are based on the assumption that SPA is 65 in 2022. Changes to legislation since this modelling took place now mean SPA will be 66.
Source: ONS PPI model estimates

The effect of improvements in mortality on aggregate income from private pensions is more nuanced. The income that pensioners receive from private pensions is dependent on a number of factors. If the pensioner holds a DB pension, the factors that will affect the income that is received are their final salary, the accrual rate and the length of time that the pension will be in payment. However, if the pensioner holds a DC pension, the factors that need to be considered are the contribution rate, the annuity rates used by the annuity provider and the length of time that the pension will be in payment. As table 4a shows, assuming no change to annuity or accrual rates, total private pension income is projected to increase under the principal LE assumption from 5.8 per cent of GDP in 2007 to 5.9 per cent in 2032. Should LE improve faster, private income from pensions could rise to 6.0 per cent of GDP under the high LE assumption and 6.2 per cent under the very high LE assumption.

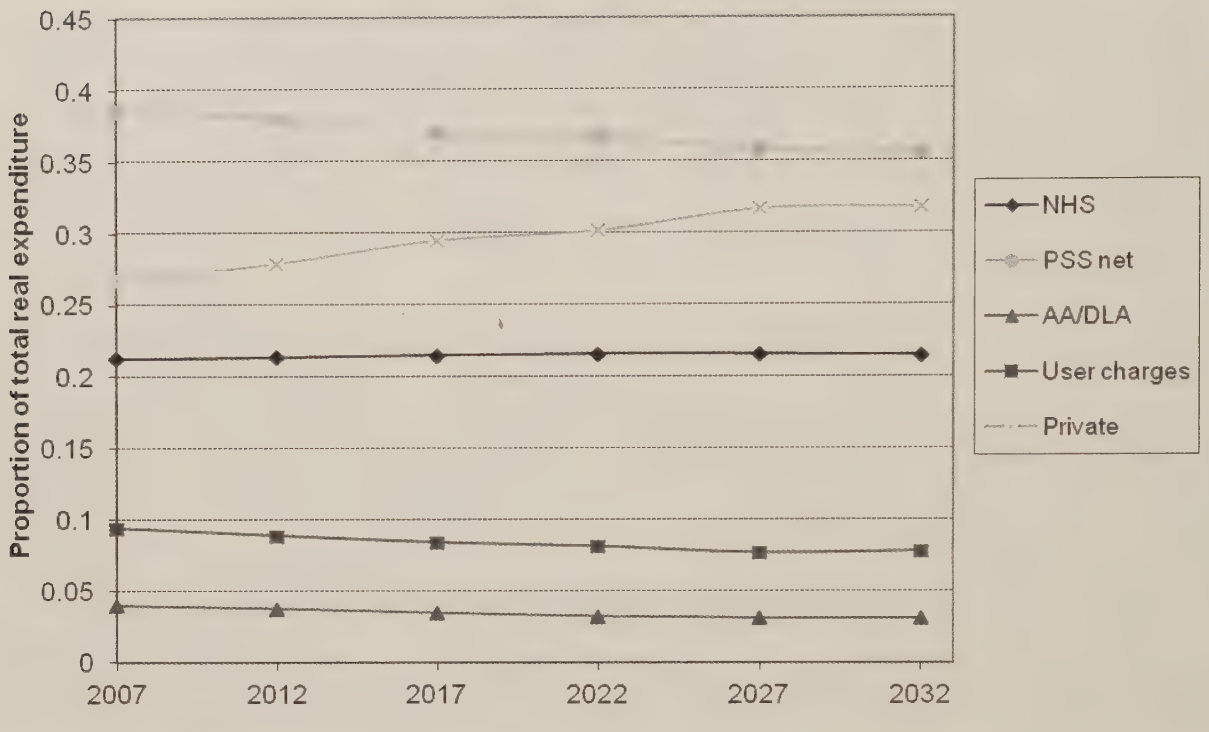
However, providers of private pensions may react to mortality improvements by reducing the annuity rates that are offered. In that case, as table 4b shows, income from private pensions would not rise as much, reaching only 5.9 per cent of GDP by 2032 under the high LE assumption and 6.0 per cent under the very high LE assumption.

Future long-term care expenditure

Sensitivity to changes in life expectancy assumptions

Under the principal LE assumptions, total real expenditure on LTC will rise from £17.5bn in 2007 to £49.9bn (2007 prices) in 2032, an increase of 185 per cent. Although both private and public expenditure increase over time, by 212 per cent and 169 per cent respectively, over time an increasing proportion of total expenditure is from private sources (see figure 1). In 2007, 36 per cent of total expenditure is from private sources (nine per cent user charges and 27 per cent is self funded), but by 2032, 40 per cent of expenditure will be from private sources (8 per cent user charges and 32 per cent is self funded). By contrast, in 2007, 64 per cent of total expenditure is from public sources (defined as NHS, Personal Social Services (PSS) and social security disability benefits) but by 2032, 60 per cent of expenditure will be from public sources, the greatest difference being in PSS expenditure which decreases by three percentage points from 39 per cent to 36 per cent. Over the same period NHS expenditure stays relatively steady at around 21.5 per cent and expenditure on disability benefits used to fund care decreases from four to 3 per cent.

Figure 1 Total LTC expenditure by source under principal LE projection, England 2007 to 2032



The alternative LE assumptions have a marked effect on both public and private real expenditure (see Table 5), although the proportion of total expenditure from each source, as shown in figure 1, remains constant across the LE variants because we do not allow for any relationship between LE and income or wealth. Under the high LE variant total expenditure on LTC is projected to rise from £17.5bn in 2007 to £52.8bn by 2032, an increase of 201 per cent. By contrast, under low LE assumptions total expenditure is projected to increase to £47.0bn by 2032, an increase of 168 per cent; and under very high LE assumptions total expenditure is projected to increase to £55.7bn, an increase of 218 per cent.

Table 5 Long-term care expenditure, by expenditure source under variant life expectancy assumptions from 2007 to 2032, England

£billions

		2007	2012	2017	2022	2027	2032	Percentage increase 2007-2032
	Public	11.2	12.9	15.3	18.7	22.9	28.4	153.7
	Private	6.3	7.5	9.3	11.6	14.9	18.6	193.7
LLE	**Total**	**17.5**	**20.5**	**24.7**	**30.2**	**37.7**	**47.0**	**168.2**
	Public	11.2	13.0	15.5	19.1	23.8	30.1	168.9
	Private	6.3	7.6	9.5	11.9	15.5	19.8	212.2
PLE	**Total**	**17.5**	**20.6**	**25.1**	**31.0**	**39.3**	**49.9**	**184.6**
	Public	11.2	13.1	15.8	19.6	24.7	31.8	184.2
	Private	6.3	7.7	9.7	12.2	16.1	21.0	230.9
HLE	**Total**	**17.5**	**20.8**	**25.4**	**31.8**	**40.8**	**52.8**	**201.1**
	Public	11.2	13.2	16.0	20.1	25.7	33.5	199.7
	Private	6.3	7.7	9.8	12.5	16.8	22.1	249.6
VHLE	**Total**	**17.5**	**21.0**	**25.9**	**32.7**	**42.4**	**55.7**	**217.7**

1 LLE low life expectancy variant, PLE principal life expectancy projection, HLE high life expectancy variant, VHLE very high life expectancy variant

Source: PSSRU and CARESIM model estimates

As table 6 shows, in 2007 public expenditure on LTC was roughly 0.9 per cent of GDP. Under each LE variant examined here public expenditure as a percentage of GDP is projected to increase in future years. Under the principal LE projection public expenditure could reach around 1.6 per cent of GDP by 2032, but under the low and very high LE variants public expenditure could reach between 1.5 per cent and 1.7 per cent of GDP by 2032, respectively.

Table 6 Long-term care public expenditure as a percentage of GDP, under different life expectancy assumptions from 2007 to 2032, England

Percentage

		2007	2012	2017	2022	2027	2032
England regime	LLE	0.9	1.0	1.1	1.2	1.4	1.5
	PLE	0.9	1.0	1.1	1.2	1.4	1.6
	HLE	0.9	1.0	1.1	1.3	1.5	1.7
	VHLE	0.9	1.0	1.1	1.3	1.5	1.8
Partnership	LLE	1.0	1.0	1.1	1.3	1.4	1.6
	PLE	1.0	1.0	1.1	1.3	1.5	1.7
	HLE	1.0	1.1	1.2	1.3	1.5	1.8
	VHLE	1.0	1.1	1.2	1.4	1.6	1.9

1 LLE low life expectancy variant, PLE principal life expectancy projection, HLE high life expectancy variant, VHLE very high life expectancy variant

Source: PSSRU and CARESIM model estimates

Effect on expenditure of a partnership scheme

The effect of implementing the partnership scheme on public expenditure as a percentage of GDP, including expenditure on disability benefits used to fund care, is shown in Table 6 under variant LE assumptions. Depending on the LE variant, by 2032 the current funding system could cost the state anywhere between 1.5 per cent and 1.8 per cent of GDP. By contrast the partnership scheme could cost anywhere between 1.6 per cent and 1.9 per cent of GDP. In effect, the partnership scheme would add an extra 0.1 per cent of GDP to the public cost of LTC, which is roughly equivalent to £1.3bn to £1.5bn over the current funding system by 2032 depending on whether LE improves in line with the principal or very high LE variant respectively.

Future expenditure on long-term care and pensions

Table 7 brings together estimates for state expenditure on both pensions and LTC as a percentage of GDP. State expenditure on pensions is roughly five times expenditure on LTC in 2007. However, by 2032, pension expenditure is about 3.5 to four times greater than LTC expenditure.

Under the principal LE assumption and assuming that pension and LTC funding policy does not change, the combined expenditure of both programmes rises from 5.6 per cent of GDP in 2007 to 7.8 per cent in 2032. However, should mortality rates decline faster, then public expenditure could reach 8.1 per cent of GDP under the high LE assumption and 8.6 per cent under the very high LE assumption. Were the partnership model for LTC funding to be implemented, state expenditure on pensions and LTC in 2032 would be higher by an amount equal to roughly 0.1 per cent of GDP under each LE assumption.

Table 7 Public expenditure on long-term care and pensions as a percentage of GDP, under different life expectancy assumptions, England 2007 to 2032

Percentage

			2007	2012	2017	2022	2027	2032
Current funding regimes	PLE	LTC	0.9	1.0	1.1	1.2	1.4	1.6
		Pensions	4.7	4.8	5.1	5.3	5.5	6.2
		Total	**5.6**	**5.8**	**6.2**	**6.5**	**6.9**	**7.8**
	HLE	LTC	0.9	1.0	1.1	1.3	1.5	1.7
		Pensions	4.8	4.9	5.2	5.4	5.7	6.4
		Total	**5.7**	**5.9**	**6.3**	**6.7**	**7.2**	**8.1**
	VHLE	LTC	0.9	1.0	1.1	1.3	1.5	1.8
		Pensions	5.0	5.1	5.4	5.7	6.0	6.8
		Total	**5.9**	**6.1**	**6.5**	**7.0**	**7.5**	**8.6**
Current pension regime and partnership model for LTC	PLE	LTC	1.0	1.0	1.1	1.3	1.5	1.7
		Pensions	4.7	4.8	5.1	5.3	5.5	6.2
		Total	**5.7**	**5.8**	**6.2**	**6.6**	**7.0**	**7.9**
	HLE	LTC	1.0	1.1	1.2	1.3	1.5	1.8
		Pensions	4.8	4.9	5.2	5.4	5.7	6.4
		Total	**5.8**	**6.0**	**6.4**	**6.7**	**7.2**	**8.2**
	VHLE	LTC	1.0	1.1	1.2	1.4	1.6	1.9
		Pensions	5.0	5.1	5.4	5.7	6.0	6.8
		Total	**6.0**	**6.2**	**6.6**	**7.1**	**7.6**	**8.7**

1 PLE principal life expectancy projection, HLE high life expectancy variant, VHLE very high life expectancy variant

Source: PSSRU, CARESIM and PPI model estimates

Discussion

Improvements in LE have two effects: they increase the size of the older population and they increase the numbers of people living into ever older ages, such that the numbers of oldest old are projected to grow more quickly in the coming decades than the older population as a whole. Over the period examined here, from 2007 to 2032, the effect of improvements in LE on state expenditure on pensions and LTC is intuitive; expenditure on pensions and associated benefits is projected to rise in future years because of the increasing numbers of pensioners – more recent projections allowing for the further policy changes described above confirm this, and show even faster growth (PPI 2011) ; and expenditure on LTC is projected to rise, although at a faster rate than pensions expenditure. The faster rate of growth in LTC expenditure is partly a consequence of the faster rate of growth of the oldest old group compared to the older population as a whole, as it is at the oldest ages where need for care is the greatest.

If LE improves more than is assumed under the principal population projection, the effect on state pension and LTC expenditure could be quite substantial. If LE rises in line with the high LE variant then by 2032 Government would need to find an additional 0.2 per cent of GDP to finance the pensions system and an additional 0.1 per cent GDP to finance the LTC system. Should LE follow

the very high LE variant then by 2032 Government would need to find an additional 0.6 per cent of GDP, equivalent to roughly £11bn, to finance the pensions system, and an additional 0.2 per cent of GDP, or £3.4bn, to finance the LTC system. The effect of improvements in LE on pensions and LTC expenditure taken together provides a starker picture since the programmes considered together represent a substantial amount of state expenditure, projected to rise from 5.6 per cent GDP in 2007 to 7.8 per cent of GDP by 2032 under the principal LE assumption and 8.6 per cent under the very high LE. Given the uncertainty surrounding LE projections it is important that the Government allows for the possibility of faster than expected improvements in LE when considering the potential costs of policy reforms and considers the effects that improvements in LE can have on multiple systems when considering the affordability and sustainability of state funded programmes.

Income from private pensions is also projected to increase over the period examined here, although the rise is significantly more modest than that found for state pensions (and could be further tempered if pension providers reduce annuity rates in response to increases in LE). This pattern can be understood as a consequence of policy changes. Thus income from private pensions increases initially, but starts to fall back as DB is replaced by DC. However, spending on state pensions increases over the period as the numbers over SPA increase and pensions become more generous.

Private expenditure on LTC is projected to grow faster than public expenditure on LTC over the period examined here accounting for 40 per cent of total expenditure by 2032 compared to 36 per cent in 2007. This is due to an increase in the proportion of care recipients who fund 100 per cent of their care, which is largely explained by further increases in owner-occupation at the oldest ages. The reliance on private funding highlights the challenges there are around reforming the LTC system, since most private expenditure is out of pocket and a small proportion of people can face costs that are 'catastrophic': it has been estimated that seven per cent of people aged 65 will face lifetime care costs of at least £100,000, and 5 per cent of at least £200,000 (Fernández and Forder 2011). Policymakers will need to respond to these challenges in taking forward proposals for LTC reform.

The partnership scheme examined here as an alternative to the current system was designed to address some of the perceived failures of the current system, notably that it produces significant unmet need (Wanless 2006; Commission for Social Care Inspection 2008) and creates disincentives to save and plan for LTC needs (Mayhew *et al.*, 2010). The particular version of the partnership scheme modelled here would require the state to find an additional 0.1 per cent GDP by 2032 to finance it, irrespective of which assumption about improvements in LE is made.

A key question that we have not addressed in this paper is how and from whom funds to meet higher state spending on LTC or pensions, whether as a result of funding reforms or higher LE, would be raised. Thus we are not able to comment on the effects of alternative methods of raising the revenue that we project would be needed for a partnership scheme or other reform to the LTC funding system or to keep pace with higher LE.

A further limitation is that we have accounted only partially for the links between spending on pensions and LTC at the micro level, which are important for understanding the effects of potential reforms. Since LTC is a means-tested system any increases in pensioners' incomes and wealth

shifts the balance of funding away from the state onto individuals. Making state pensions less generous would shift the balance of funding for LTC from the individual towards the state. Understanding and being able to quantify the effect of changes to both the state and private pensions, such as raising the SPA and the move from DB to DC plans, on the LTC system will help to identify appropriate funding models for the future.

There are also some limitations associated with the modelling that are likely to affect the figures presented here. We have not modelled a link between improvements in LE and socio-economic status. However, it is possible that the gains in LE will be concentrated amongst wealthier older people (Nazroo *et al.*, 2008), which is likely to accentuate the trend towards individuals taking a greater burden of responsibility for payment of LTC. It could also increase private pension income more than state pensions and means-tested benefits since it tends to be wealthier individuals who have private pensions and by definition are less likely to be entitled to means-tested benefits in retirement.

In addition, in both the LTC and pension modelling we have not taken into account changes in behaviour resulting from reforms. We identified that a more generous system may lead to increased demand for care. However, it is also the case that residential care and nursing home providers may react to changes in the balance of purchases for places by state and self-funded residents. Self funders currently pay higher fees for their places than state-funded residents so any change in the balance of self-to state-funded residents will affect provider income and the sustainability of the homes (Hancock and Hviid 2010). Equally in the pensions context, the savings behaviour of individuals may be affected by auto-enrolment into pensions and other planned changes in the pension system. This could be a direct effect, changing the amounts that individuals save, or an indirect effect through the behaviour of employers and the levels of contributions that they offer into workplace pension schemes. Given the considerable changes in both the state and private pension systems in recent years, future behaviour may be very different from that seen in the past.

Policy reform in the area of pensions and LTC is a rapidly moving field and we have not included in our modelling some planned-for changes to the pensions system, notably the Coalition legislation to bring forward the increase in SPA, the provision of the 'triple guarantee' mentioned earlier and the move to the use of the Consumer Price Index (CPI) for uprating of state pensions. Since the original announcement on the first of these, the government has decided to put back the increase by six months. The long term link of BSP to the triple guarantee may also come under pressure given the fact that the CPI is rising considerably faster than earnings. We have also not taken into account forthcoming reforms to public sector pension schemes resulting from the recent Hutton Review, restrictions on the availability of tax relief on pension contributions (from April 2011), and the ending of the requirement to purchase an annuity with the proceeds of a DC pension by age 75 (from April 2011). Nor have we taken into consideration any of the state pension reforms proposed by the Government in its recent Green Paper (Department for Work and Pensions 2011).

The assumptions about GDP that we are using are likely to be optimistic since they pre-date the financial crisis. More recent figures released by the Treasury for short-term growth are lower than those assumed here. However, the long-term projections for annual real growth used in the model are lower than those currently assumed by the Treasury, meaning that the long-term projections of the proportion of GDP absorbed by LTC and pensions would not be substantially changed and if

anything are slightly too high. Additionally our assumptions about wage growth in the LTC sector may be high for the short-term since they assume a two per cent real rise in staff costs. Given pressures on local government budgets and current trends in the wider economy such a rise seems unlikely unless restrictions on immigration push up costs. Previous work has demonstrated the sensitivity of projections to changes in unit costs (Malley *et al.*, 2006; Wittenberg *et al.*, 2006), so if wage growth is slower it will offset some of the cost increases due to improvements in LE.

Conclusion

The purpose of this analysis has been to assist decision-makers developing proposals for the reform of the systems for state pensions and for LTC of older people. This is in the context of continuing debates about both these systems. The debates have been prompted partly by concerns about equity and fairness but substantially by concerns about the future fiscal sustainability of public expenditures on the Welfare State in the face of ageing populations.

The analysis shows that projected future expenditure on pensions and related benefits and on LTC for older people is sensitive to variant assumptions about future mortality rates and life expectancy. Moreover the projected future costs of specific reforms are also sensitive to variant assumptions about future mortality rates and life expectancy. This means that policy-makers developing reform proposals need to recognise that, since future life expectancy is inevitably uncertain, there is considerable uncertainty about the likely impact of demographic pressures on future public expenditure on pensions and LTC. They need to prepare in particular for the possibility that the pressures could prove greater than would be expected on the basis of the ONS principal population projections.

The projections presented in this paper, by considering the pensions and LTC systems together, take a step toward drawing together the debates on reform of the two systems. It seems appropriate that reforms of these two systems should be considered together since both affect the resources and well-being of the older population and both raise issues for financial decision-making in middle age, especially decisions relating to saving for old age. Joint policy debate on these two issues would be greatly assisted by joint analyses. Further research looking in more detail at the interactions between pension and LTC reforms in the context of uncertainty about the size of future demographic pressures on public expenditure on these two services would be very valuable.

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